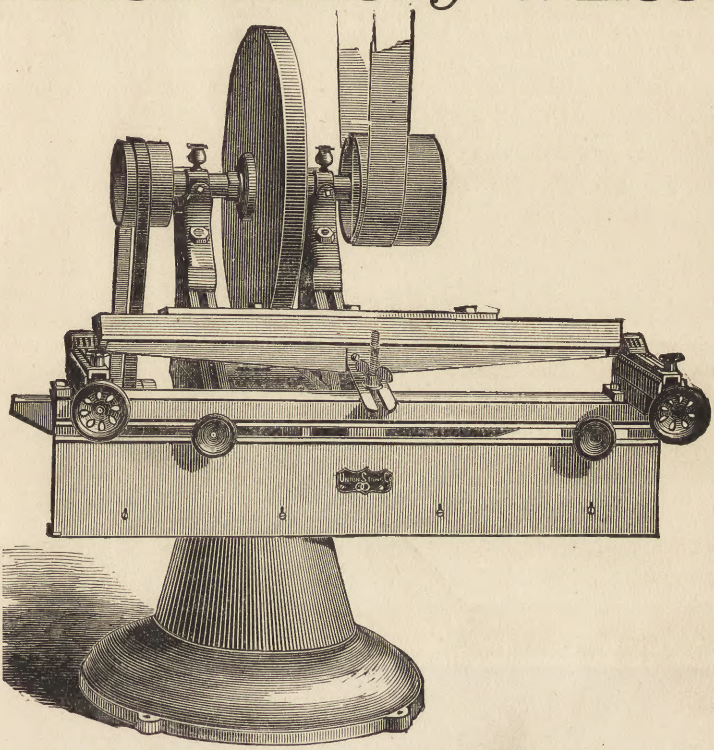
UNION STONE COMPANY, 38 & 40 Hawley St., BOSTON, MASS.

Patentees AND

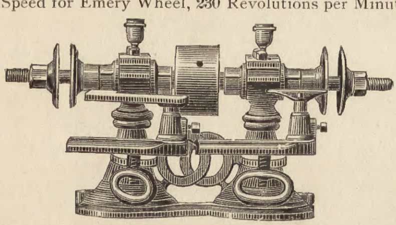
Manufacturers OF THE

DIAMOND TOOLS FOR DRESSING EMERY WHEELS.

Union Emery Wheel



Union Stone Company's Patent and Improved Automatic Knife Grinding Machine, for grinding planing machine knives, book binders' currier, long knives and shears of all kinds. Size, 24, 36, 50, 80, 100 and 120 inches. The grinding wheel is 26 inches in diameter and 1½ inches thick, with patent sliding boxes, so that the wheel can be entirely used up. This machine soon pays for itself in the labor it saves. It will grind a knife in less time than on a grindstone, and with a perfectly straight edge, in itself a sufficient reason for purchasing the machine, to say nothing of the economy. Speed for Emery Wheel, 230 Revolutions per Minute.



NO. 0 MACHINE, ¾ INCH ARBOR.

Emery Wheel Machinery and Tools

A SPECIALTY.

Automatic Knife Grinding Machines, Wood Polishing Wheels, Emery, Quartz, Corundum.

GRINDERS' AND POLISHERS' SUPPLIES.

CATALOGUE ON APPLICATION.

Truly Yours
John Kane
Observer.

SHAVINGS AND SAWDUST.

BY "OBSERVER."

COMPRISING A SERIES OF ARTICLES, SOME OF WHICH HAVE APPEARED IN "THE LUMBER WORLD" FOR THE PAST TWO YEARS, AND ARE NOW REVISED, TOGETHER WITH MANY OTHERS WHICH HAVE NOT BEEN PUBLISHED; ALL TREATING OF THE

DESIGNING, CONSTRUCTION, CARE,

—AND—

OPERATION

—OF—

WOOD-WORKING MACHINERY

WITH ILLUSTRATIONS.

C. A. WENBORNE, BUFFALO, N. Y.

1884.

PREFACE.

SOME two years ago when requested by the publisher of THE LUMBER WORLD to write some articles on the general subject of wood-working machinery, the writer hesitated for a considerable time on account of his inexperience in writing on any subject, realizing that while he might be more or less qualified by his practical experience, it was a different thing to tell what he knew in a manner at once interesting and acceptable to that portion of the public interested in the various subjects since written upon. It was, therefore, with not a little reluctance that these articles were commenced.

Finding that they were received favorably by those most interested in such literature, it was resolved to revise and make them more complete, and to add to them enough to include the general line of machinery used in planing mills, sash, blind, and cabinet factories, car shops, etc. They were calculated to interest not only operators, but purchasers and owners as well, and are dedicated to such in the hope that they may be able to extract therefrom a little knowledge by which they might profit.

They treat of the designing, construction, care, and operation of the machinery mentioned above, and are full of shop matter, interspersed with actual incidents that the writer has observed or had connection with. If they show more of the wrong ways of doing things, it is only to show the folly of the same, and as a friendly warning that the reader might not go and do likewise. Several of these articles have been copied in many of the leading mechanical and trade journals of the country, and the writer has felt that at least a few have read and regarded them with favor. They contain many hints concerning methods of operation, good

and bad, written to operators, good and bad, by an operator (good or bad) and comprise a book which is perhaps the only thing of the kind now published. Wood-working machine operators have never had an opportunity to fill their libraries with books relating to their trade anyway. The writer in a humble way is trying to change the order of things in that respect.

JOHN KANE.

ROCHESTER, N. Y.

CONTENTS.

CHAPTER X.

CHAPTER XI.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

CHAPTER XVII.

CHAPTER XVIII.

CHAPTER I.

A PLAN FOR THE ECONOMICAL DRESSING OF LUMBER.

TO design and build a mill or factory for wood-working purposes is an undertaking that involves the consideration of numerous questions, such as the location, size, foundation, shipping and handling facilities, storage room, insurance, power, and space for enlargement, etc. These questions, together with many others, present various phases in each particular case, and could be discussed at great length without becoming thread-bare.

Planing and moulding mills require more room than almost all other kinds of establishments using a similar amount of capital in machinery, etc. This is true of nearly all kinds of wood-working shops, including sash, door and blind, cabinet and carriage factories. The amount of power required is also greater, but on the other hand, the building for a planing mill, while substantial and well adapted to its purpose, can be erected comparatively cheap. Its principal requirements are good foundation for the machines used, rigid supports for the line and other shaftings, plenty of light, and room enough to hold at least one day's work under cover in case of storm.

During the past decade I have been in a great many mills, and have seen not a few that were admirably adapted to the business of handling and dressing lumber at a minimum of expense and labor, and I have occasionally seen one that seemed to me to have been built and arranged to see how much expense could be put on each job and yet have every one about the place work hard all day. But of these last I will not give more than a passing notice. In many of them it seemed as though machines had been left where they were dropped by the drayman on their first arrival. The grindstone was where the rip saw belonged; the resawing machine should have been placed where the flooring machine was; the surface planer was where nothing should be except perhaps, a pile of lumber, and so on all the way through.

A

A great difference can be made in the production of work by the proper or improper location of the different machines. By

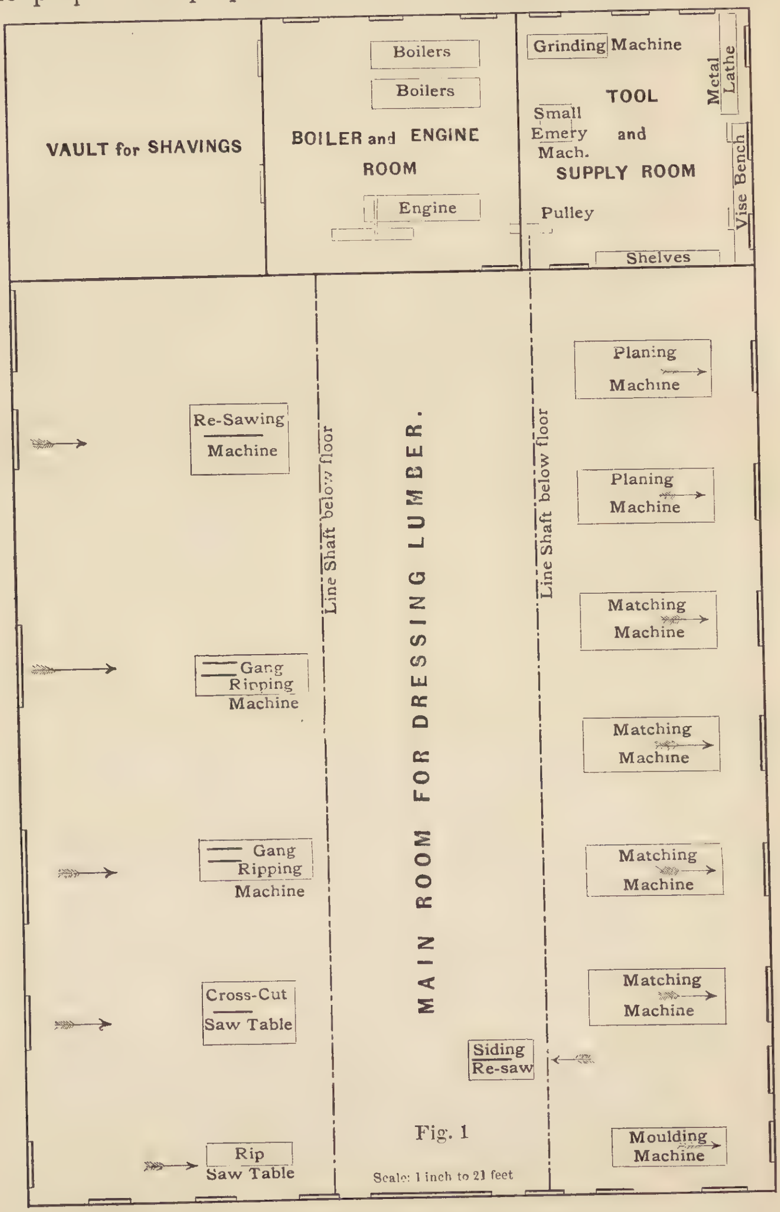


Fig. 1

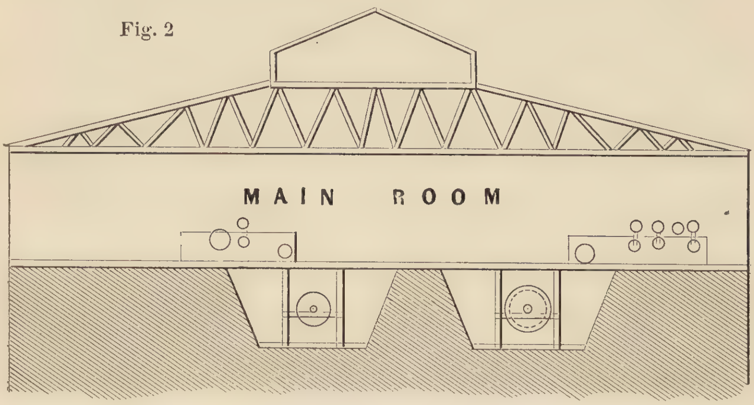
the proper location of machines, I mean so placing them that all the various processes, including ripping, cross-cutting, re-sawing, surfacing, matching, and moulding can be done with the least pos-

sible amount of handling. Every time a piece of stuff is touched, carried, or handled unnecessarily, some of the profits, if there are any in the business, stick to it. It is not a hole in which to drop money, but a good surface on which to stick the needful. As an illustration, when boards are dressed on a double surfacing machine at a very close figure after the cost of power, grease, and help are included, where would the profits go to if the same work were done on a single surfacer feeding at the same rate? You simply stick it on the boards with good "stickem." It will stay there and don't forget to keep this fact in your cranium.

If I had a planing mill to put up so that it would not "go up" and do a sheriff's business, I would "scheme" out a mill where, as far as possible, all lumber would come in rough at one side or end, and go out finished at the other.

There have been shown from time to time many plans and

Fig. 2



diagrams of "model mills" that have had their advantages, and not a few having many disadvantages. Whether the tale or plan I am about to unfold is better than others, I will not argue. There are a few good features about it that I think will commend it to those interested. It is intended for what might be termed a manufacturing mill, that is, one that does a large amount of work of a kind at a time, and consequently avoids that everlasting stopping and changing of machines incident to jobbing mills, for which an entirely different plan might be adopted.

The plan shown is intended to provide for two surfacing machines, four matchers, one moulder, two gang ripping machines, one rip-saw table, one crosscut-saw table, one large re-saw, and one siding, re-sawing machine, also shavings vault, boiler and engine room and tool room. The scale is one inch to twenty-one

feet. This gives in the lumber dressing room a size of 104x80 feet; shavings vault, 28x28 feet, boiler and engine room 28x28 feet, and tool and supply room 28x22 feet.

The elevation is drawn on the same scale as the plan, and is shown here more particularly to illustrate how the line shafting can be placed under the floor and still be easily accessible, also the absence of posts, leaving a clean sweep for the manipulation of lumber, the only thing that will rise above the machine tops being the exhaust pipes, which from their location will not be objected to.

On the plan (fig. 1) the arrows indicate the direction of passing the lumber through in its various processes. The re-sawing machine, the gang ripping machines, the rip saw table and the cross-cut saw table are all located at one side of the building, having plenty of space in front of each for piling lumber which can be dropped from the wagons driven in the large doors. The machines are driven by the line shaft below the floor. As the lumber is taken away from the various saws it is laid opposite each planing, matching or molding machine, and fed through them out of the doors or apertures to the shed outside of the building, or otherwise disposed of for convenience. All siding can be planed and jointed next to the siding re-saw, which has ample room behind it for a large quantity of lumber. The shavings vaults should be fire-proof as well as the boiler and engine room. In the tool and supply room are located the grindstone or automatic emery grinding machine, small emery grinding machine for moulding cutters, a large closet or tier of shelves for cutters, saws, files and other supplies, a vise bench with machinist's and sawyer's vise, and a metal working lathe. The dotted pulley receives the main belt from the engine band wheel driving the line shafts (dotted lines), one of which is driven by a cross belt from the other, which in this plan is not objectionable because of its ample length and large-sized pulleys, and also for the reason that it will be the only cross driving belt used. Besides, should any accident happen to either line of shaft at any place except the driving length of the first shaft, the other can be used by uncoupling the shaft.

Referring to the elevation (fig. 2) the plan of placing the shafting underneath will be seen. Two trenches are excavated for each line of shafting, about 8 feet deep, and wide enough for the hanger frames, and passage way for oiling, inspection, etc. A connecting trench will of course have to be excavated for the belt driving the second or sawing machine line.

The machine room is intended to be 16 feet high in the clear at the lowest point, having a truss roof and skylight center the whole length of the building, and 20 or 25 feet wide.

By following the arrow indicating line of travel, we find wide boards travel from the re-saw to the two surfacing machines, and thence out. The flooring, siding, etc., are first edged through the ripping machines to the matching machines. The mouldings first pass through the rip-saw table to and through the moulding machine, the only backward movement being from the matching machine to the siding saw, which in this case saves re-handling, and allows of its disposal to as good advantage as any other plan. By this plan ample room is had to pile lumber in front and behind each machine for the next handling, and there is plenty of space to get around and between all machines. Teams can also be taken through any part of the building with a load, which is dropped at the desired place. Plenty of air and light are provided for each department, and as near as possible a place is provided for every thing needed for a first-class mill. In considering and designing this plan I have to state that there are many successful mills having many of the features here shown, and to them I have added some of the minor details that are very often not thought of or considered.

Two of the most successful, as well as largest, mills I have seen have been built on this plan, and are considered to be almost unexceptionable in their appointments, one of them dressing 2,225,000 feet per month, and using the same number and kind of machines shown with less "help" than many other mills doing a great deal less business.

This plan easily admits of enlarging to an unlimited degree. One has only to "add on" to the end. The disposition of the shavings vaults and boiler and engine room, together with the fact that they are fire-proof, materially lessens the high cost of insurance. Now I do not claim that this is a "model mill," but feel conscious that its having been tried with good economical results, having plenty of room for all wants, and machines generally well disposed, will argue its own merits.

CHAPTER II.

BUILDERS OF WOOD-WORKING MACHINERY—ROZENS' PRISON SHOP AND WORK, AND ROBINSON & CO.'S SYSTEM.

I HAVE often been struck by the difference in the design and construction, as well as the price and durability of machines intended for the same purpose, and wondered why such a wide difference was tolerated by purchasers, the most of whom could readily detect the contrast without a magnifying glass. It seemed to me that purchasers in need of a particular machine would buy the same kind—the best, of course. I don't mean that they would buy from the same firm, but from some manufacturer that sold a good, acceptable article for the purpose—one that is known and read of by men to do good work and plenty of it at a minimum cost of production.

Well, I find that they don't do anything of the kind. They just buy at any and every place where machines for the purpose are advertised. They are just as liable to go to some job shop where such a machine was never seen, and order one, if they can get the proprietor to build it, as to go to a shop where they build nothing else, and the machine was made cheap, durable and simple—in fact, perfect.

I had heard that Rozens had the knack of building the cheapest machines to convert wood (into shavings), so one day while traveling in his section of the country I thought I would spend a little time and see how he did the thing. After doing up the town, I started for Rozens' shop, and being acquainted with him I had no difficulty in getting a peep through the works. I saw and was convinced. I can pledge you my word that if you want a cheap planer and matcher, surfacer, band saw, saw table, upright shaper, turning lathe, or any similar machine, that the place to go is Rozens' shop. Why, he showed me cast-iron matcher heads to hold three knives each, that had never seen a drift or file in the mortise holes! You could buy a cart-load of them for a handful of silver.

He says that he has a patent on them. Perhaps the claim is in not getting the foundry sand out of or off them. He can make a bed plate for a surfacer which raises and lowers without the aid of any planed surfaces,—four chilled surfaces rubbing against one another, also *finished* in the foundry (he has no planer to take them in); he can give you an iron frame, wood top upright shaper or moulder with two spindles, countershaft included, for about the same price as you would pay for a good countershaft made anywhere else, or you can get a saw table, all iron (and wood), for a mere song. He can show you a first-class planer cylinder head that was cast in the foundry with the shaft in all ready for the lathe, with a little planing. He has the shaft hacked up by the blacksmith and sent to the foundry with the patterns: says that occasionally one comes from the furnace a little loose, but he just drills a hole and whacks a pin through it, and then it is all right. He has a sickly looking shop, with everything in a heap: the pattern, machine and blacksmith shop, casting cleaning room, and office all in one; lathes that look as though they had attended three fires and a funeral, and were not buried on account of the expense; a drill that some country blacksmith had thrown away and under which Rozens had put a saw horse to get it up from the floor; drills and reamers that would not cut; dogs that might properly be called curs because of their mongrel look; a lot of vises and an old anvil and forge, with other old trash that would make any junk dealer scent the shop a mile off. His wrought iron, castings, patterns, and lumber were all to be found in one pile up in the corner, provided you could find them at all. He had a lot of men in the shop that one would mistake for old prison birds, although they did not look particularly criminal only when a stranger came in and found them there. They seemed to work and act as though that were crime enough.

After a while Rozens got a glued table top jacked off, and told a machinist to bolt it on the saw frame. Then he sat down to entertain me. He told me what an immense business he was doing (he had eight men and boys), how his trade had increased (from what to what), and that his great forte was in designing machines that could be made cheap. He said that he was going to start a branch shop over in Canada to catch the Kanucks' trade; he was going to send his castings over and build the machines there, and thus avoid the heavy duty. Finally he asked me what I thought of the plan and his machines. I told him that he could build the machines and finish them completely in the States, and

then take them apart and ship them all as castings, and that in regard to the quality of his machines I thought he could not be beat as a designer and builder of cheap machines. He thinks I am a queer fellow who does not seem to understand that the great American people want cheap machines. Rozens certainly builds cheap machines, but I have yet to hear of a customer who ever bought a machine from him which was cheap. They are cheap, dear machines, or dear, cheap machines, I can hardly say which.

Perhaps it would be a good idea for the government to pension Rozens, and other machine builders of his kind, or get up a foul conspiracy and have him exiled. One of his whilom customers says that Rozens mistook his calling. Upon being asked what trade he should have learned he replied that he might have been a baker and then what he spoiled he could have eaten, and if he could not have eaten it fast enough he could have bought swine and fattened them on the balance. Some of these customers are very sarcastic and unkind in their remarks.

I have forgotten to mention Rozens' signs. They are re(a)d. white and blue all over,—large letters and small letters, on the doors, windows, cornice, bricks, and every other possible place, My first idea upon seeing his shop was that the train had taken me to the wrong city, and that I was going into one of the "Bowery" side shows, where they exhibit a fat woman, live monkey, stuffed skeleton, sixty-foot anaconda, &c.

Robinson & Co. have for a long time held out an invitation to me to visit their factory, and so I went the other day. They build a line of machinery for performing various kinds of work on wood. They have been in the business since they were big enough to work at anything. They have taken the several degrees of apprenticeship, journeymen, foremen, and proprietors; they have swept floors, cleaned castings, turned rolls and arbors, and fitted them in; they have put whole machines together and operated them as employees of other people, and they have designed and constructed the machines you find illustrated in their catalogue. They build machines as good as can be found; they keep abreast of the times in regard to improvements. Every machine that comes from their shop or bears their name looks like one that will fill the bill. It does what it is advertised to do. I know this, for I have seen them in operation.

Their machines are built in the *machine* shop. All they ask the moulder to do is to furnish them with good, sound, clean,

castings, without any machine work added,—only this, and nothing more. They have planers, lathes, milling machines and drill presses, capable of doing any part of the work required. More than this, they have a full assortment of twist drills, reamers and taps, which they buy where such things are made a specialty of. Robinson & Co. say that they are more successful in building wood-working machinery than machine shop supplies.

I saw a man planing a lot of cylinders for planing machines. He had not only good tools, but a template for every line and curve that he cut to. He told me that he had over two hundred tools for his planer, some of which had not been dressed for ten years, as they were all kept for their special purposes. This man is turning a shaping spindle and will have it all finished before the frame of the machine is set up. Perhaps you think that he ought to leave a light cut to true it up with after the babbitting of boxes is done. Oh, no! No babbitt will be poured on that spindle. There are babbitting shafts for each spindle on every machine that is built in that shop. All the machinist has to do is to go to a certain rack and find a shaft marked "U. S. B. A." He knows those letters mean "Upright Spindle Babbitting Arbor." Robinson says it costs as much to get up or buy the small special tools for manufacturing machinery in these days of sharp competition as it does to furnish large tools such as planers, lathes, drill presses, etc.

Their pattern shop and loft is arranged in the same way, as are also their blacksmith shop and iron room. Patterns are classified and arranged so that each complete set for a machine is to be found together. There is no hunting after patterns or core boxes, no swearing or loss of temper on their account. The pattern maker knows that it is his business to keep the patterns in good repair and in their proper place, and he does it. The blacksmith has drawings and patterns for all the forgings required for the various machines, together with the numbers. He can take you to the iron room and get you a piece of tool, machine, or Bessemer steel, Norway or ordinary bar iron, either flat, round, square or hexagon, in the dark, if necessary. He knows where each quality and kind of stock should be kept, and always finds it there.

We get back almost to where we started and find a machine about to be tested before shipment. Looking overhead we see countershafts with belts so arranged that any machine can be started up and tried on short notice. The machines are never found wanting because they are built right to a system, and all alike every time. If you should find a small detail that has been

overlooked or set wrong, you know that Robinson & Co. will be glad to make it right. They are jealous of their reputation, and are more than liable to tell you plainly if you are not using their machines fairly, even if they have been paid for them six or eight years before. They are not extending their shops into Canada or China, or anywhere else, but have made additions to their business right at home and find all the trade they can attend to.

Robinson & Co. have more money invested in patterns, drawings, special tools, templates, &c., for one machine, than Rozens has in his whole shop, and yet the former make money where the latter could not. If Robinson & Co. were to build the same kind of machines that Rozens does they could sell them for less than the latter's cost price and make more money, but you couldn't get any machines of the Rozens stripe at Robinson & Co.'s establishment. If you were to call for them or refer to that class of machinery you would be told that they did not aspire to that kind of competition.

Rozens knows very well what the character of his machines are both in weight, quality of stock, and workmanship, and yet he has the most serene countenance and earnest manner when telling you that he builds machines that have no superior.

CHAPTER III.

WOOD WORKING MACHINE OPERATORS; GOOD AND BAD, AND WHY—A FEW REQUISITES FOR SUCCESS.

THREE or four years ago Becket bought a machine for dressing wood and seemed to be well satisfied with his purchase, at least he so expressed himself for about two years after buying it. It turned out lots of good work, cost nothing for repairs, and ran with a minimum amount of power. After he had used the machine two years matters changed considerably and there was a good deal of "teaming" to the city for repairs and duplicates of broken parts. At first this was not noticed particularly by Boone the builder of the machine, neither did Becket offer any remarks about it, but as the calls became more frequent Boone began to scratch his head for an idea. He was busy and did not like to run his shop wholly on repair work. Then Becket began to grumble about the machine being built from poor iron and steel. He also insinuated that Boone ought to hire competent mechanics, and suggested that the repairs be made of steel and wrought iron, and his bill for repairs compromised or at least heavily discounted.

Boone could not account for the breaking of the parts of the machine in this manner as he always put in the best materials to be had for the purpose, and was certain that he had a lot of as good machinists as were ever gathered under one roof. This remark in regard to the machine having been built by incompetent mechanics "riled" him, as he had always paid the highest wages to secure the best, and also had a first-class O. K. machine shop in all its appointments even to special tools for the smallest detail used in the construction of each machine.

Becket's temper did not improve very fast. His customers were waiting for work that was behind time, and this repair business was flattening out his pocket book very rapidly. Every time a piece was wanted he had to send the team away to the city for

a whole day besides incurring all the other necessary expenses. Boone's foreman did not like to have that old red wagon hanging around the shop door. It was a standing accusation against him, and he knew he was innocent. One day it was backed up to the door of the shop as usual with a lot of broken stuff to be repaired or duplicated—gears, shafts, pulleys, cutters, etc. Foreman asks teamster "What do you folks mean by smashing things up so? Guess we'll have to move our shop out next door to your factory if this keeps on." Teamster said that when they had Barker who had started and run the machine at first they had no trouble. Everything went along well enough, but when winter was coming on Becket proposed to cut down Barker's wages until spring. The latter would not submit to this so he left and soon found a better job.

The canal runs alongside Becket's mill, and he actually hired a mule driver to operate his machinery, whose sole experience consisted in piling lumber in a lumber yard at the other end of the route for two or three weeks in the spring before shipping on the "raging canawl." Becket did not have to pay the "canaler" as heavy a salary as he had paid Barker, but he more than balanced it with what he paid the machinist, to say nothing of the cost of transportation, delays, etc., besides making a fourth-rate second-class machine out of what a short time before was a superior machine for the purpose intended.

Now Becket should have known that there was something wrong about the machine "driver" by comparing notes. Barker had no repairs while the machine was under his care, and the canaler did; the power was the same, the machine was the same, the work was to be the same, the man was different. He could have gone farther in his reasoning. Boone had always given him first-class work at reasonable prices including this machine; he had built hundreds of them just alike and they were pronounced successful by the hundreds who had bought and used them. Boone had thoroughly tested each one of them, including Beckets, before shipment, and knew that they were a success, therefore, clearly the machine was not at fault.

I understand that the mule driver has resumed his old vocation and feel sure that Becket will not hire any more men because they are "drivers."

I presume that there is no branch of industry calling for so much mechanical knowledge and skill as the care and operation of wood working machines, where men are hired who have never

served any regular apprenticeship or have had so little preparatory education. I don't know why this should be, but nevertheless it is a fact. There is no calling among the industrial pursuits which demands more knowledge, skill and good judgment. A man who is thorough in all its branches has at least the parts of various trades at his fingers' ends. He must understand enough of the machinist trade to make or suggest repairs and improvements; must be something of a draftsman or designer to lay out and execute new kinds of work demanded by the trade; should know enough about carpentry and building to take orders and fill them correctly; should be a good judge of lumber and know how to sort and cut up the same to the best advantage and profit; be able to erect and place machinery and shafting properly in the absence of a millwright; be a competent judge of all supplies, such as belts, oil, knives and such things that have to be replaced from time to time; and should be able at any time to operate any machine about the place, even to running the engine and keeping it in order if called upon. In addition to all these things he should give as much spare time as possible to studying up mechanics, and especially the parts pertaining to his occupation.

To all these qualifications should be added self interest in the business, industry, sobriety, economic habits, and an ambitious desire to advance. Men are neither better or worse at this trade than at any other. Luck or chance will advance or degrade no one, but superior knowledge and education, combined with good judgment and perseverance, always make their mark.

I know many men who a few years ago were "jours" or foremen, now conducting a prosperous business for themselves while their former shopmates are still plodding along in the same old ruts or working for them. These men are bound to prosper because they possess all the elements of success and do not recognize such a word as "fail" while their fellow workmen never advance, a few go backward, and some are "tramping."

I call to mind now two men of about the same age who started to work in a shop years ago. After John had worked at the business for a few years he gradually advanced until he became foreman, then superintendent of the whole place, afterwards a partner, and finally sole proprietor. He had no legacy left him or any outside assistance of any kind, but he had a good deal of energy, good judgment, and business tact, and every Saturday night laid away a certain sum for a "rainy day." (He owned an umbrella which he kept for the same purpose.)

He always paid cash for anything he bought and got the best of everything; was well dressed when off duty; attended a good opera or show occasionally, and lived well in a cosy, comfortable little cottage where you could generally find him evenings. His employers always found him at his post every Monday morning; he made six full days every week unless sickness or holidays prevented; he never ran any accounts "across the way" but very often his shopmates called him a "greeny" to throw his money away when he bought some book of art or mechanics from an agent that happened in. He did not run around every Fall or Spring looking for a house worse than the last, because he was his own landlord. His children were well dressed and his wife was happy. This was the kind of luck or chance that John had and that every one else can have if he only applies himself.

Peter worked as long as John at the business, and at the same wages for a long time, and finally became foreman. He went along swimmingly for a time, but prosperity did not agree with him. He donned a high silk hat and boiled shirt, went around at nights and was one of the "boys." In the mornings, particularly on Monday, he had a head on him so big that it pained him to have anyone come near him. His employers finally "got on to him" as the boys say, and discharged him.

He went to John for a job, but John did not have room for him just at that time, in fact he never does, so Peter walked around pounding the pavements until finally he struck a job taking lumber from a machine, at the usual rate of wages for such work. I saw him the other day. He doesn't wear a plug hat or boiled shirt now. He drinks cheap whiskey when he can get some one to buy it, and smokes a dirty clay pipe.

When he is at home you will find him in the alley opposite John's new stable, if the Board of Health has not cleaned him out. I don't know whether the Poormaster helps Pete's family or not (they need it) but I saw the public provision wagon driving into the alley the other day.

A few days ago I gave Pete a quarter. He said he had "to see a man" and pay him the balance of his rent. He thinks that this is a hard world and that John has had good luck with him all his life. The latter told me a short time ago that Peter might have been his partner or had a good business himself had he started out right and worked to get to the top.

CHAPTER IV.

PROPER TOOLS—NEGLECT OF OWNERS TO FURNISH THEM—ADVANTAGES OF HAVING THE BEST.

PROPRIETORS of mills, when estimating the cost of building and setting in operation any planing mill or wood-working establishment, should always bear in mind the very important fact that one of the best investments about the whole plant consists in having good facilities for keeping the different machines in good working order with the least possible delay and cost. These facilities do not necessitate a very large outlay in proportion to the cost of the whole, and will show a larger percentage of profit than any like sum invested on any other part of the mill. Of course one cannot have a whole machine shop at hand, but a few small tools carefully selected and placed at the disposal of an intelligent foreman, will save many tedious delays, to say nothing about having machinery in good order at all times, and getting ready for any part that may need repairs so that it can be put in order on the shortest possible notice.

As a general rule, purchasers and owners do not pay much attention to this matter, thinking that when a full outfit of engines, shafting, and machinery are bought and set up in the building ready for operation, they have everything needed in that direction, and the machines will run themselves, without any repairs. In this they are sadly mistaken, as they soon learn to their cost and sorrow. I think that one reason for this lies in the fact that many machine builders, in their anxiety to sell and please the purchaser, make big promises as to the length of time their various machines will run and produce good results, without any perceptible wear or need of repairs.

Now, the truth of the matter is, that machinery of all kinds, and especially high-speeded wood-working machinery, no matter how perfectly designed and constructed, will not run for any great length of time without deterioration unless under the watchful care of a competent foreman or operator, and it is reasonable to

conclude that even these men need facilities at hand to perform quickly what is required to have their machines always in that perfect condition requisite to produce a large quantity of superior work.

I have furnished machinery for a great many mills, new and old, visited and inspected a great many more, and have seen them in all conditions, but have failed to find many that were fitted with a view of being thoroughly labor-saving, systematic, and orderly in their appointments. I have known men to expend large sums of money on costly machines, a nice line of shafting, first-class belting, superior engines, exhaust fans, etc.—all the best to be had in their several places. Then they hire a good man to take charge of the mill, and expect to have everything go off all right and do large quantities of work at the minimum cost of production, with no expense for wear and tear or repairs for some time. But things don't go right. The engine crank gets hot; belts slip; couplings on line-shaft get loose; saws, knives, etc., get dull. These things happen one after another. They must stop and repair this and that during the day, and at six o'clock they notice that the pile of dressed lumber falls far short of their expectations, and what the different manufacturers had assured them could be done.

The owner breathes a prayer for Mr. Planer Builder or Mr. Engineer who designed his pretty, but not very serviceable engine, and puts in a powerful petition for Mr. Exhaust Blower and poor O. K. Hemlock who made his belts, and does not forget to mention his foreman before he says Amen.

To all who have had such experience, and profited thereby, I have nothing to say, but to those who think that their production should be greater and better; their wastage less; their repair bills smaller, and that their machines should be in better condition, and also to those who contemplate building and operating a model mill, I say "don't forget that to erect, set up and operate your machines daily, the foreman must have the proper appliances and tools to perform these functions." He must have a good tool room. Yes, I know that you are running a planing mill and not a high-toned machine shop, but it is absolutely essential to have these things and a proper place to use and keep them. Never build a mill, be it ever so small, without reserving the best lighted corner for a tool room, and when you board the train for the place where you will purchase your machinery, don't forget the memorandum with a list of tools for your tool room. Let me look at it, if you please.

"One iron vise, about 5 inch jaw; one heavy and one light hammer; two flat chisels, one half-round chisel; one ¼-inch cope, one ½-inch cope, and one ¾-inch cope chisel; flat, half-round, and round coarse files, with handles for same; two screw wrenches (10 and 12-inch); a steel straight-edge three feet long; iron frame spirit level; plumb bob and line; a try-square: large and small oil cans; screw-drivers; one pair of inside and outside calipers; a speed indicator; a babbitting ladle and some good babbitt; complete set of bits; tools for hook studs or lacing wire; hooks for cleaning out oil holes; a pair of balancing scales; a set of iron gauges for the different sizes of tongue and groove used in mill, also a matcher setter." That is an excellent selection for a good start. When you get home enclose your corner for tool room, and don't forget to procure an automatic knife-grinder or at least a good set of hangings for a grindstone frame and an attachment for grinding knives—all these the best that can be obtained. The automatic grinder can be bought for $90 to $100, and these things when placed in the hands of a competent man will pay for themselves in a very short time because he can always keep his machines in order more easily and quickly, and instead of shirking the otherwise disagreeable job of repairing and adjusting from time to time, it will be attended to promptly, and the machine, belt, exhaust and engine men, and foreman will all hear the song of praise instead of the curse of ignorance.

I recently sold an outfit for a large mill, and the manager gave the superintendent carte blanche for his tool room outfit, adding in his order that if the superintendent had forgotten or overlooked anything necessary I should furnish it. This resulted in a list of articles like the one just mentioned.

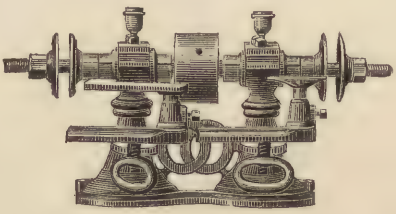
Now I will wager my diamonds against a nickel that a person can step into that mill at any time and find the machinery running in good order and doing first class work, and the proprietor will not say in a few months, that the machine started off all right, but it does not work so now, and that there is something mysterious about it. No, he will find these tools to be the best and most essential investment in the whole mill. You can no more expect a mill to be kept in good order without them than you can eat a meal comfortably without knives, forks or dishes.

For a large mill or factory having a number of machines to keep in order I would advise the following additions to what I have already mentioned: One small forge and anvil which will be found useful and convenient in melting babbitt metal and for forging,

dressing and tempering knives, cutters, bolts, etc.; one engine turning and screw-cutting lathe to swing 20 inches diameter and 5 feet long, fitted with an 18-inch independent chuck for boring, etc.; one set of drill-sockets for twist drills; one set of twist drills from ¾ to 1 inch 1-16 of an inch; one set of flat or chuck drills from 1 to 2½ inches by 1-4 of an inch; four sets (4 each) chucking bolts ⅝ inch diameter, 4, 6, 8 and 10 inches long; two sets of clamps or straps for holding work to the face plate or chuck; one set of taps and dies from ½ to 1 inch by ⅛ inch. Also the following lathe cutting tools: Two diamond points, for turning; one round nose, for finishing; two boring tools, one 4 inches and one 8 inches long; one inside threading tool; two outside threading tools; two side-cutting tools, one right and one left; two parting or cutting off tools ⅛ and ¼ inch.

These tools added to those absolutely required for any small mill or factory would make an outfit for a tool room not excelled by many machine shops, and costing less than $1,000 would soon prove to be yielding a handsome profit on the investment. They could be in charge of the foreman and operated by the man who sharpens the knives and cutters, saws, files, etc., to very good advantage.

If an engine stud got broken, a cutter for a new kind of moulding was needed, a screw to be made or repaired, a pair of cutter head boxes or a loose pulley to be re-lined, besides other repairs too numerous to mention, you would soon appreciate how much better and more quickly they could be done on the spot than to travel a long distance to a machine shop employing persons who do not really understand what is needed, to say nothing about fitting all small new work within the range of these tools promptly, and keeping them ahead or in stock. You may rest assured that were this whole plant to come into use only one-sixth of the time and lie idle the balance, you would be money and time ahead, not counting the worry and profanity felt, if not expressed, at the usual machine delay and botch work.



CHAPTER V.

VARNEY'S EXPERIENCE WITH FOREMEN—TROUBLES—THE MAN FROM THE "HUB"—VARNEY FINDS A REAL DIAMOND.

VARNEY owns a small jobbing mill and box factory, has had considerable trouble in getting and keeping good men, and especially a foreman. He was relating his troubles some time ago; first he had Davis who was a very good foreman when tied down to a day's work on any machine in the building, and would work at all hours, even Sundays, sharpening cutters, filing saws, packing joints in steam pipes, cleaning the boiler, or doing anything else to keep the various machines running full time—in fact, he kept himself so busy that he had no time to look after the men and keep them busy. He was sober, and careful about the expense account to a painful degree, asking for any small needful supply as though craving a great personal favor. Varney said that the mill did not yield a fortune while he had Davis.

Next, Wallace came along and he ran in an opposite groove to that of his predecessor. In two weeks every person about the establishment was wishing that he would pick up his grip sack and follow Horace Greeley's advice. He kept everything in bad shape. "He was not going to worry and fret about all the little details," but he took good care that those under his charge did. Not a man around the place ever saw him smile. Things came to such a pass that the machines were idle very often, and the good feeling existing between Varney and his men was in such great danger of being terminated by a strike, that Wallace had to go.

While on the lookout for a new foreman, one of the old hands, Scott, was called to fill the place. Varney says the chief fault with Scott was that he did not know how to sort and cut lumber unless it was for kindling wood. A piece of clear stuff was just as liable to go with a pile of barn boards or be cut into common

box stuff as anything else. Now Varney says that a large per cent. of the profits is due to the perfect knowledge of sorting and cutting up stock, and I rather guess there is more truth than poetry in his assertion. Scott told him that the men ought to know which side of a board to plane, which edge of a board to save for first, second or third quality when sorting from the rip saw, and which piece to save for a panel or use for box boards when cross-cutting. Varney insisted that it was the foreman's business to know these things, so they parted, as Scott would not go back to work in that factory as a common "jour" after having been a foreman. Of course he would have no objection to the same kind of a job in another place even at less wages. He had not the moral courage to go back and work at what he could perform well, at the same time studying to advance himself preparatory to getting another and better position, but he had a good deal of what he called pride which he imagined was badly damaged, in truth almost wrecked. Through this false pride many people as well as Scott allow hundreds of opportunities and dollars slip by them.

Soon after this, Varney's factory took fire and two machines were all that was saved from the wreck. These he had rebuilt. While building his new factory and getting machinery he corresponded with Bidwell who was in the same business, in regard to a foreman, and the result was the recommending of a man who would just suit him. I saw Varney one day before he got his machinery started. He said, "I tell you, Observer, I'm going to have things different from what they ever were. I have a foreman coming who will show you how to run wood-working machinery. He has been foreman in some big mill in the East, but the climate there doesn't agree with him, and the doctor recommends a change for his health. He is coming from Boston."

After the man from the "Hub" had arrived, I happened into the mill one day, and as I passed by the vise bench I saw two planing knives, that evidently had not been on the planer ten days, all bent and broken. I walked up to one of the machines and as a matter of habit put my hand on one of the boxes to see if it was running cool and steady. Cribben (the new foreman) came along and I pleasantly asked him how the machines worked and suited him. In a very gruff manner he intimated that perhaps I knew all about them as I had been examining them. As he had the reputation of being an expert I thought I would keep cool and probably could catch some of the drippings of wisdom with which

he was overflowing, so I apologized. He then became confidential and told me that this machine should have been thrown into the scrap heap instead of being rebuilt; that machine yonder could not be made to work properly; the shafting was wrong, and in fact nothing seemed to suit him. One cylinder had its bearings re-babbitted inside of a week. When pressed for the cause of this he said he never knew of new bearings that did not heat and melt out. I gently reminded him that every time the bearings were re-lined they were new, hence, according to his idea they would always melt out. He looked at me hard enough to bore a hole through me, and to this day I don't know whether he saw the point. When I went into the office I told Varney that perhaps he had a rough jewel of a foreman who might possibly improve with a little polishing; also, if he would tell me what Cribben ate in this glorious climate I would tell him what he *drank* both here and elsewhere. Varney said Cribben would do better after he got the hang of things and he guessed he would come out all right in the end. Well, the final result was that he did not come out all right at the end; his boards even did not match right at the ends as very often they were narrower there than any place else. One thing Cribben could do to a nicety—he could bring the edge of a glass to his lips every time he found about three *fingersful* in it, which was very often.

Varney says no man can drink and tipple all night and do right by his employer or himself the next day. He also says such things have a bad influence on the men, and besides, machines don't perform so well when they are tipsy. Do machines imbibe intoxicants? Cribben had to go.

Varney is hoping that Pendleton will stay with him, because he just fills the bill. He came from the little town of Pineville where he had charge of a small establishment, and as he had lived there all his life he conceived the idea that he would shake the dust of Pineville from his feet and go out into the "wide, wide world," trusting to chance to get employment.

While at Pineville he had but little opportunity to make much of a show, as the shop he was in did not have a very extended business or number of machines. There were a great many machines in use that he had never seen even a picture of, but he applied himself closely to his trade and read everything he could find relating to his business and mechanics in general. He never found time to hang around the village depot or corner tavern evenings. He had no machine shop within fifty miles of the

place, but he could babbitt a box or bearing, straighten a shaft, or even go to the boiler furnace, heat an old broken bolt and put a head on it that would astonish many good blacksmiths who had all the required facilities at hand. His cutter heads never melted out the boxes, nor did his saws get all buckled up, and if they had he could have hammered them out as well as any sawyer. He was a first-class mechanic without knowing it.

But proprietors in need of such men are not long in finding out what stuff a man like Pendleton is made of. He came into Varney's office and asked for a job. Varney inquired where he came from and what he could do. Now Pendleton was a modest man who did not toot his own horn (figuratively speaking) very loud, but in a quiet way answered all of Varney's questions. The latter was so favorably impressed with his unassuming manner and appearance in general that he finally offered him the duties, responsibilities and salary of foreman of the establishment instead of setting him to work at a small moulding machine as he had first thought of doing. This proposition rather took Pendleton's breath away at first, as it was unexpected and much higher than his ambition had soared just then.

What he was looking for was a job—some situtation where he could get an insight into the ways and manners of doing business in a city, and also see how machines were constructed for use on work that he had never done. He requested the privilege of looking through the establishment for a few hours and said he would give an answer at the end of that time.

Well, he began his tour of observation and found that while Varney's shop was much larger and more varied in its work than any he had been in, and also had three times as much machinery, some of which was new to him, there was really not so much difference as he had imagined. The saws simply cut stuff crossways or lengthways, the planer just planed it, the moulder made mouldings of any shape or form that the knives were made for, just as had been done in the little shop at home. He concluded his inspection, accepted the position, and was at once placed in charge. The men, some of whom had been there half a lifetime, didn't like the idea of a green country chap coming into the place and "bossing"—that was putting on the hayseed too thick.

But Pendleton paid no attention to their little piques, he simply went about his business, and in two weeks everyone about the place knew that he was master of the situation, because he always knew what he wanted, when he wanted it, and who he wanted to

do it. He had a quiet, easy, and yet commanding way of talking to or ordering the men that was not to be gainsaid. In a short time every machine and man was working like clockwork. More work was being done and in an easier and better manner, and yet there had been no upheaval of things, as everything had been quietly changed and put in order at a very slight expense.

When Pendleton goes to the office and says he wants anything ordered for the mill, no matter if it should be something unusual, it is ordered at once because Varney knows that "No" will not be taken for an answer, and besides he has faith in Pendleton's knowledge of the wants of the business.

There is an all-prevailing sense of cleanliness and system about the place. Every piece of work goes out on the duplicate system ; repairs from accidents are almost wholly unknown ; there is no friction between the foreman and employes ; machines use only a minimum amount of power as per the tell tale on the boiler, and yet Pendleton doesn't seem to be very busy, but he keeps his eyes open and thoughts busy, and seems to make every move at exactly the right time and place. He is fast becoming a polished jewel, and in the near future Varney will have to increase his business, as no little shop can hold such valuable men; they are in too great a demand. Pendleton will never have to look long for a situation. His good qualities will advertise him and make a demand for his services at almost any kind of a salary. To tell the truth, I know of several men who have their eyes on him now.

What made him so much superior to Wallace, Davis, or Cribben ? He was not naturally so, neither had he worked in so many different places nor had as good opportunities for observation and general experience. He simply interested himself in his business and was determined to excel, if possible. His spare time was largely drawn on to improve his mental education, and he always had money enough in his pocket to buy any good book that he came across that he thought would give him at least one idea. He commenced at the bottom and studied first principles, and ferretted out the reasons why machines and their operations should be thus and so. He was rather quiet than otherwise, and reluctant to express his opinion unless he felt well posted on the subject in question. He did not condemn every machine and tool he had charge of, he simply made them do the best they could until he could get something better. In a word, he was bound to get to the top where men are not crowded so much, and he has succeeded.

CHAPTER VI.

HARRISON & HENRY BUY A "NO. 1" BOILER—A FEW POINTS REGARDING THE CONSTRUCTION OF A GOOD BOILER.

I WAS in Harrison & Henry's office, not long since, and being an old friend, stopped to have a chat with them. Our conversation was quite lengthy, and eventually turned to steam boilers. As they had recently put one in, together with a new engine, I was invited to visit the engine room and look at it. The masons had not finished the setting or bricking in, so a very fair view was obtained.

The boiler had five flues and was about ten feet long, forty-two inches diameter. Some of the sheets were double riveted; that is, they were too short to reach around, and two sheets or parts of sheets were riveted together. These joints were placed at almost all parts of the circle in the various lengths and some of them looked as though a person had cut a "gutter" along every joint that should be caulked neatly, and said "gutter" left off. It did not enhance the beauty of the boiler, and would probably weaken it. One of the heads bulged out at least two inches at the center, —I presume this was to accommodate the various lengths of flues— and there were also to be seen at least three rivets that did not fill the holes; evidently had been drifted together sufficiently to allow a forced entrance of the rivet to the hole. There was a brand or stamp on the boiler head which read "C No. 1," and another stamp found on one of the shell sheets which said "C No. 1 shell;" there was also a huge dome on top, and the fire front had a large spread eagle design with the full address of the attempted boiler maker. It came from a little shop owned by Bloom & Co., who are located in a small town, and who also make sleigh runners, corn shellers, plow points, and everything else they could think of that there was any money in, including engines and boilers. Harrison said I was too sarcastic when I told him that

Bloom & Co. had been palming off some old foundry cupola on them, and Henry hurriedly proposed adjournment to the office, there to fire up, smoke and criticise a Havana, imported from the nearest cigar store.

I do not think that Bloom & Co. ever saw the inside of a first-class boiler shop. If they did they certainly did not show it on Harrison & Henry's boiler. Upon being pressed for ideas regarding the kind of boiler as the best, together with the quality of material and method of construction, I began to be somewhat cautious in my remarks. You see my practical education in boiler construction has been somewhat neglected. But I have seen boilers that were good in all that the word implies, and, while not an expert in that line have been a very careful observer of the same. I have noticed that of the various styles of boilers the greatest number are of the horizontal tubular type. This is especially the case in wood-working establishments. It combines in a compact form a large amount of heating surface, has no superior in economic use, and is easily managed. Its advantages in connection with good construction from the best materials, and its comparative safety and durability cause it to be recognized as the standard boiler for stationary purposes in this country. In some sections where the water forms scale rapidly, cylinder, or two or five flue boilers are generally used, but in such cases better results would no doubt be obtained by using a feed water heater and purifier, of which there are many good ones in the market which will prevent or remove the said scale in the tubular boiler.

It is the general custom to compare prices of the different manufacturers of boilers, by the horse power. This leads to serious mistakes. Bloom & Co. might figure their total horse power by every nine or ten feet of heating surface, and some one else figure his by every fifteen feet. Two boilers with equal amount of heating surface may produce widely different results in practice, owing to the difference in their proportions. A long boiler of a stated diameter is cheaper than one which is larger in diameter and shorter, both having the same amount of heating surface, but the heating surface of the latter will be more available if it be properly proportioned than the former if improperly proportioned as to length. A good general proportion for wood-working factory use is about ten feet long for a shell of forty inches diameter, to fourteen feet for a sixty-inch shell with three inch tubes. Before going farther, I would say that there are many good boiler makers who, on the score of safety, will not make a shell larger than sixty

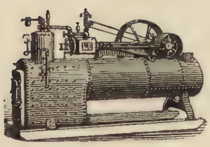
inches in diameter, but in case they are made the tubes should be increased to 3½ inches for a sixteen foot, and 4 inches for an eighteen foot boiler. An intending purchaser who gets bids from numerous builders would receive better results for his money, and would give better satisfaction to those making figures for him, by furnishing some specifications regarding the quality of material used and method of construction. These specifications can easily be obtained from some one well versed in boiler construction.

The iron for the shell and heads should be what is known in the market as "C H No. 1 flange iron," and the sheets directly over the fire "C H No. 1 flange fire box" iron of a tensile strain test, not less than 50,000 pounds. Do not be deceived by reference to "first-class, best Pennsylvania," &c., but get the exact brands as above. These brands from reputable iron manufacturers can be relied on as the best. The sheets composing the shell should be long enough to reach around without piercing, with the girth seams well up out of reach of the fire and double riveted. Regarding the comparative merits of hand and machine riveting, which has received much attention of late years, each has its strong advocates. No doubt good work can be done by machine, but it is also certain that poor work has been turned out, although doubtless by careless workmen and manipulation. This perhaps is the principal reason why many good makers still do their riveting by hand. Regarding the number of tubes in a boiler, care should be taken that they be not crowded in so as to impair the circulation and tend to produce "foaming." It is conceded that they should be from one to one-and-a-quarter inches apart; as large a hand hole as is possible should be placed below, and if the water is very bad a man hole in the front head is better, placed of course underneath the tubes. All boilers of 40 inches diameter and over should have a man hole on the top. Rivet holes, spacing, and punching or drilling, should receive careful attention so that they will coincide exactly when "rolled" up ready for the rivets, and thus avoid the use of drift pins to force them in alignment with each other. There is just as much sense and reason for using drift pins for this purpose as for a man to stand on his head to look at the steam gauge. Years ago boilers were considered by some incomplete without a dome, and even now there are those who think they must have one. Of late years, however, the advantages of this attachment have been seriously questioned. It is a source of weakness to the boiler, and is of little value as a steam resource, while its claim of producing "dry" steam is fre-

quently doubted. A dry pipe placed along the top of the boiler, arranged so that the steam travels through the perforations previous to its passage to the steam pipe for use, is preferable, and the weakness caused by use of dome avoidable.

These are a few of the leading features that come to my mind at present regarding the type and construction of a boiler for supplying steam power for wood-working machinery. There are many minute details not mentioned that can be obtained from those engaged in their manufacture, also information regarding grates, fronts, connections, water and steam gauges, safety valves, setting, &c., together with drawings and specifications for their erection.

Although steam boilers are one of the most important parts of the whole plant, and at the same time the most dangerous to life and property when carelessly used, I need not here set forth the causes of the failure and success of the same after being ready for use. I will only add that the whole matter can be summed up in a short sentence: Buy only the best, have it complete in all its appointments, and engage the services of a competent engineer.



CHAPTER VII.

A "BLASTED ENGINE," WITH NOTES ON ENGINES IN GENERAL.

I MADE no mention of the new engine that was to go with the new boiler of Harrison & Henry's, not through neglect, but because it did not go with the boiler—that is, at the same time. The reason of its delay was this: Bloom & Co. did not have to make patterns for the new boiler, while at one time and another they made a good many for this particular engine as they had not built one of so large a size before. Some people can make more machines from the same patterns with a few slight changes than others can with infinitely more patterns: they know how to do it, you see; it is easy enough when you know how.

Those who are saving on their pattern-making account, regardless of all other expenses, can furnish either a water wheel case or cupola base from the same pattern, and with equal facility extract from a lathe bed pattern an engine frame, or a pulley from a spur gear pattern. To be sure the lines of beauty or utility are absent, and the proportions may not be exactly right, neither does the bank account seem to grow apace as expected from such a policy, but somehow this state of affairs continues in many places.

The aforesaid engine must have been evolved, revolved, or extracted from just such a lot of patterns. The frame was about as high as it was wide, and about as thick as a good stove plate. It was evidently intended to be rigid and solid, because its sides were "tied" together with numerous cross girths 4 or 5 inches deep and fully ½ inch thick; it was about 10 feet long, at least 22 inches wide, and fully as deep. It had been originally intended for a smaller size of engine or engine lathe frame, and when looking at it alone without its engine attachment, one would be pardoned for pronouncing it a first class water trough. I think it would be a good plan to place a placard on it with these words "notice—this is an engine bed." This would avoid wear and tear of brain work done in the guessing line.

Well, Bloom & Co. had to make new cylinder, cross head, and pillow block patterns. There was a chance to spread steam science, and metal. The cylinder had to be four inches larger in diameter than the old pattern, but the stroke the same. That cylinder I believe would actually weigh more than the frame. No fear of getting a collapse there by frequent re-boring. No sir; Cylinders must be heavy you know to stand that. Another convenience about this cylinder was that no one had to stoop to look at the oil cups; it stood about up to the second button of an ordinary man's coat (provided the buttons were all there). The piston may have been good, bad or indifferent, I did not see it as it was out of sight; the cross head was a marvel of workmanship, with an array of oil cups, bolts, nuts, washers, gibs, etc., all finished on the good old O G Style; the pillow block acted as though it had kept company with the frame long enough, and would take a trip with the crank. This was the third pillow block. The first one did get away one day in a very unceremonious manner; then the second one was "weighted up" considerable, and it concluded to get off unless released from duty which was finally agreed to. The crank seemed to be well proportioned for its work, but not for its surroundings. The valve not having any severe strain seemed to be all that was necessary. To sum up the whole matter—every part seemed to have been taken from an engine of a different size and all the parts from as many different engines.

When I first run against it just inside the engine room door I instinctively commenced to back out, but Harrison was behind me and asked what I was afraid of, it wouldn't bite. Of course I wasn't "skeered" but then I prefer to see an engine behave itself in the presence of visitors. I remarked that there was no sense in having a stationary engine on rolls, and received an answer that my specs were deceiving me, as that engine was bolted down firmly to a solid foundation. When I had wiped the steam from my glasses I found this to be the case, and also that the engine did move from one end to the other. In fact it was a genuine reciprocating engine. It was finally admitted that the crank plate might be out of balance a trifle, and that the bed was none too heavy, also that Bloom & Co. would have to set things right before the final payment was made. I think that some time in the not very distant future Harrison & Henry will have a lively appreciation of the fact that the motive power constitutes a very important part of cost of plant, and on its performance depends to a considerable degree the successful operation of their establishment.

As I stood there the engineer gave me a knowing wink and said, "she is a blasted engine." After leaving the engine room I began to cogitate on the subject of engines—their purchase, adaptation, construction, etc., with the following results:

The best way is to purchase an engine from some well known engine builder who makes them a specialty, assuming that in these days of progress those who make certain machines a specialty devote more thought and study to attain perfection than those who put very little of these needful ingredients into any of the numerous machines built by them for widely different purposes. You will notice that Bloom & Co. are not quoted as authority, or even as having any rank or standing with any of their different machines. There are lots of good responsible engine builders whose guarantee for the preference of their products need not appear on paper, because they can turn in any direction and show any number of their engines that are a source of pride to the builder. In fact I might say that they will be good monuments when their creator is not of this earth. They are also an equal source of satisfaction and comfort to the purchaser and engineer when under decent treatment and care.

There are three distinct types of stationary engines offered in the market, viz., the automatic cut-off, fixed cut-off, and plain slide valve, all having under certain circumstances their particular advantages for the special uses to which they are put. You pay your money and take your choice.

The first named, in most short stroke high speed engines, has besides the main valve to control steam admission and exhaust, an independent cut-off valve with the object of cutting off steam from the cylinder at the proper time as designated by the governor and may be at any point up to ¾ or ⅞ of the stroke. These engines are usually put in to do the work cutting off at about ¼ stroke which is considered the most economical point with 70 or 80 pounds boiler pressure. At the same time they take advantage of every change of load by changing the point in the stroke at which the cut-off takes place. This point is determined by the governor, and the balance of the work is done by expansion of the steam. This engine is economical in using a minimum amount of steam and fuel, and in wood-working mills where shavings, etc., form but a part of the fuel and the remainder is purchased, makes said economy an important item every day, and is a strong argument in favor of an automatic cut-off engine even at their advanced first cost. At a moderate estimate they will save from 20

to 30 per cent. in fuel under ordinary conditions, and in some cases will even exceed these figures. There are of course many different grades of these engines built—good, bad, and indifferent, and the economy of the two latter kinds would perhaps not amount to anything. They should be selected for their strength, good workmanship, simplicity and ease of management by an ordinary engineer

In the fixed cut-off there are also two valves—the main and the cut-off. The latter is set permanently to cut off at a given point of the stroke, and speed is regulated by the governor throttling the steam the same as in an ordinary slide valve engine. This type of engine is a favorite with many, because, when properly adjusted, it is a very economical engine, as it partially takes advantage of the expansion of steam, while its cost is less than that of an automatic cut-off.

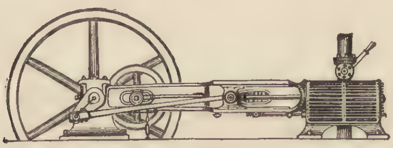
The plain slide valve engine, however, is used now, as it has been for many years, in establishments that furnish their own fuel in the production of their work, and the matter of fuel economy is of no material importance. There is little doubt that it will continue to be used as long as motive power is furnished by steam. When carefully designed and proportioned it is by no means an expensive engine either in its first cost or expense of running and management. Its very simplicity recommends it where considerations or circumstances do not exist for the use of higher type engines.

As the speed of line shafting in wood-working shops is comparatively speaking high, a short stroke and high speed engine would be the most advantageous, with a stroke about one and one-half times the diameter of the cylinder, which will allow of a large pulley on the line shaft, belting from the band fly-wheel on the engine running in the direction that will place the slack side of the belt on top. The advantages of this style or type of engine are generally understood and appreciated by engineers and mill men of modern ideas. Too long a stroke with its consequent slow speed involves the necessity of a fly or band wheel of a very large size. If the fly-wheel is small the pulley on the line shaft must be small; this shortens the life of the belt and impairs its service because it requires to be strained very tight under these conditions. The short stroke has also the advantage of less first cost, less weight, less space, better regulation and economy, than its old fashioned, long stroke, slow speed rival.

I would add that I must not be understood to prefer a high speed engine that will run so fast that economy of wear, break-

ages, attention, etc., are laid aside, but as in many other machines select the happy medium which would be for piston speed from 400 to 500 feet per minute. It is also conceded that short stroke engines must be well constructed from the best of materials to insure successful results. When you get such an engine or induce anyone else to, don't have it stuck in some dark cellar way or room; don't put it on good foundations and then enclose with a rough board shed that you would blush to put a cow in over night, and expect that everything will be kept shining and in good shape. If you do you will find you have made a grievous mistake, and the chances are that the engineer will have to be chained to keep him there. Hardly anything, even princely wages, will induce an engineer to have sufficient pride and interest in his engine, boiler, and fixtures under such conditions.

"Harmony is the support of all institutions" and especially in this case where the surroundings should be in conformity with a well furnished and designed engine, don't fail to recognize the fact that every cent or dollar expended for a well appointed comfortable engine room is not for the single benefit of the engineer but for your own special gain and satisfaction. Your engine will be well taken care of, and require less repairs because of easy access, generous light and proper ventilation. You won't have to carry a lamp or strike a match to read the gauges or see that the oil cups and "sich" are full; you will go as often to the engine room as any place else, and you won't have to borrow a suit of overalls to go in either; your engineer will not dread to come in contact with anything because it is covered with a greasy fungus, neither will he slight any little jobs he may find necessary, but will strive to keep things decent and in good order, have more comfort and yield better returns.



CHAPTER VIII.

A FEW FACTS CONCERNING LINE AND COUNTER SHAFTING.—SPLIT PULLEYS CONSIDERED.

THE line or main shafting of any mill or factory being a fixture erected for permanent use, should receive the most careful consideration. The power applied and distributed, the length and diameter, coupling to connect the different lengths properly, the number and kind of hangers or bearings necessary to keep the shafting in place with the minimum amount of friction, the size and weight of pulleys to place thereon, and finally the speed—all of these items should be considered with special reference to their several duties, as well as their relative duties to one another.

A great amount of extra power is consumed and many tedious delays caused by line shafts being poorly adapted to their surroundings. This is notably the case in wood-working establishments where the duty on shafting is often sudden and severe, especially when large machines requiring a great deal of power are quickly started and stopped. I can conceive of but few places that are worse for shafting than a large planing mill, and I might say fewer places where it receives less attention and care.

Line shafting is generally put up about right to drive the first few machines placed in the mill, and while machines are being constantly added to the original number from time to time, the shafting remains the same or rather is weaker as each machine is added. This is due to sudden strain, torsion, etc.

In looking through a few mills having about the same number and size of machines, one is surprised at the radical difference in the various line shafts. Sometimes too large, again too small; sometimes too many bearings, or else too few; often speeded too fast, and as often too slow.

If the building is one story high with a gable roof, as is the case nine times out of ten, you will find girders about twelve feet apart, with a hanger or bearing for the shaft on each—the whole

put up in a shaky manner, and when it is started running, everyone who walks under it dodges, fearing it will fall and smash things, or hurt people. There has been nothing saved in its first cost or erection worth considering, and no one is proud of the job, while every day it costs double what it should to drive it because it will not stay in alignment, gets sprung, uses up barrels of oil, wears out and breaks belts, and grinds fast in the boxes. Now all this is wrong and is the result of carelessness in not studying the cause and effect on the start.

You should give your line shafting as much serious consideration as any purchase you make for the new mill. I have in my mind's eye a line of shafting 200 feet long, that, by throwing the belts off, one man can easily turn. It is made in lengths of 16 ft. each, the first length receiving the power being 3 inches in diameter, and all the rest 2½ inches diameter, with adjustable hangers every eight feet, clamp or compression couplings at every length, and pulleys distributed *ad libitum.* It was put up running lengthwise of the building, trusses about 12 feet apart. To these were put two stringers of 8x8 stuff the length of the line, for the feet of the hangers, and cleated together to keep them from wearing, and when extra heavy duty was required they were supported from above. They were accurately aligned and levelled before any hangers were put on, and then the hangers were placed. These were adjustable in every direction—down, up, sidewise, anglewise, etc., and each one provided with a good oiler (glass). The couplings were such that you could uncouple any length of shaft in ten minutes, or couple them again, or change pulleys. The pulleys were accurately fitted, turned, and balanced; the hangers had drip cups, and the shafts plenty of collars to prevent end chase. The shafts made 300 revolutions per minute.

When this line was put in operation it was a thing of beauty and a joy as long as it was kept level, aligned, and secured. The only improvement I could think of would be to have split pulleys altogether. They cost but little extra, are neatly made, and can be put on or changed in a short time without disturbing the shaft, which is no small task when it is heavily loaded with pulleys. I would have no whole pulleys on my plate, or shaft, rather.

Now for the speed. You will find that 300 revolutions per minute is about as good an average as you can have for the machines you will use, and the shaft does not require cumbersome pulleys, lessens the liability to produce torsion or twist, and runs easily in the boxes. No matter how high the speed, don't get

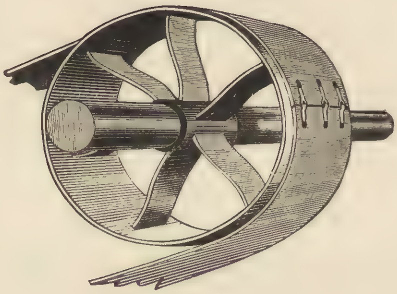
too small a shaft in a planing mill, as the pulleys being large are heavy at best, and the shocks caused by starting machines are sudden and severe.

If your building is so arranged that you can place your line shaft below the floor, do so, and put it up in the manner described, but drop it as far as possible from the joist, say five feet, so as to get length of belt. You need not be afraid of fire if you have reliable glass oilers and metal bearings. In some respects this underground plan is preferable as you have a clear room with no belts to obstruct the handling of lumber. You can also use tighteners for your belts and do away with loose pulleys (and who does not like to get rid of them?) You may perhaps have to drive a machine with an extra countershaft, but it can be done as well from below as above. Perhaps I should have mentioned that the reason glass oilers are preferred is that you can see whether or not they are doing their work, also if there is any oil in them. You will find that if you erect shafting properly, made in all its general details from the above hints, it will give no more trouble than any other machinery, and it will cost a great deal less every day for power.

In putting up countershafts always make measurements with reference to the location of pulleys, keeping them as close as possible and convenient to the bearings to avoid springing the shaft. The tight and loose pulleys can be placed at one end and the driving pulley at the other. Select hangers of a length or "drop" that will swing pulleys 30 inches diameter, which will in almost all cases be large enough; have them the same style and pattern as those on the line shaft; have all shafts the same diameter for convenience in changing pulleys and collars, and avoid turning down the ends for bearings. Rather take up end chase with collars. This plan makes the strength of shaft equal throughout and costs less in the first place in many cases. The driving pulley can be placed outside of the hangers for the purpose of putting on and taking off belts—a good plan for pony planer and other light driving machines.

It is very essential that counter shafting be properly erected—that is, perfectly level and in alignment with the shaft from which it receives its power. It should be prepared and put up on the same general plan as the line shaft, securely fastened and provided with a substantial belt-shifting attachment, which can be made of wood as well as anything else, besides having the advantage when made at the mill, of being adapted to its particular place. In the

erection be particularly careful to see that belts of ample length can be used, as short belts require much more tension, causing bearings to heat and wear, spoiling the belts and springing the shafts. So many able writers have given full instructions regarding the setting up and aligning the different kinds of shafting, that I presume it would be rather superfluous for me to give any directions on that subject. I will say, however, that it is a good deal as an old millwright once said to me: "It is a very easy job. All you have to do is to keep the shaft perfectly level and aligned" —in other words, get your line shaft right and set your countershafts parallel with it every way, and the thing is done.



CHAPTER IX.

HOW U. R. RUSHING CONDUCTS BUSINESS.

RUSHING runs a planing mill, and sash, door, and blind factory, employing about twenty-five hands. He has what might be considered a fair plant of machinery for the purpose, does a fair run of business, but does not seem to get ahead very fast. He does not know why it is, and would not thank any one to tell him. He attaches no importance to having small conveniences, such as knife grinder, matcher setter, balancing scales, etc., to facilitate and cheapen work about the establishment. As he claims to be a practical man at the business, he does not have to depend on a superintendent or foreman—saves that extra expense, you know! which is quite an item every year.

In the morning on entering the mill he attempts to set everything in motion, lays out work for the day, loads up his wagon and delivers goods, buys stocks, drums up customers, keeps books, and in fact does everything, and gets around after dinner in time to take something to the machine shop, belt factory, or edge tool works to be repaired or ground, etc. I think there is hardly a day but what something is drawn off in a wagon for repairs.

These are the kinds of establishments that make plenty of work for the machinist. One day it is a cylinder that has cut out the bearings, next a gear is broken, then a belt has been spoiled for lack of a proper shipping guide to ship it and keep it in place. Then the knives have to be carted away two or three miles to be ground and balanced; a shaft coupling fails to perform its duty, so the shop is shut down and the "boys" take a holiday, and thus it goes on throughout the year—never a day when *all* the machines are in order to be operated.

If a person goes into the mill he involuntarily dodges under the line shaft, which has a pulley turning like an eccentric, or a loose pulley grinding out music that is anything but classical, making enough noise to deafen him, or, perhaps, he sees a boy driving a board through the matching machine with an *axe*, perspiring at every pore, and calling on the Deity in no very reverent terms.

Going to the opposite end of the surfacing machine, or re-saw, he will be almost suffocated by the shavings and dust, and yet there is a good exhaust fan of ample proportions.

The carpenters and builders grumble and growl that they did not order stuff for *wash-boards*—what they did want was flooring and smooth-surfaced boards. They would also like to see two sashes or doors alike when they are so ordered, threaten to withdraw patronage, and finally compromise by cutting off a heavy discount from the bill.

Poor Rushing, who really is to be pitied for the large amount of hard work he does every day, cannot see why it is that he does not make any progress, especially when he is such a thoroughly practical man, brought up in the business, working at all the different branches, from carrying lumber into the mill, to carrying the finished work away. His men have an easy time; every one is his own boss, and Rushing, by hook and crook, gets their salaries for them regularly every week.

I have known of a first-class cutter-head in one of his machines that had to be re-fitted and the boxes re-lined three times in two weeks. First, after it had been re-lined and re-fitted and run for three months, it suddenly stopped one day and would not turn. He had a machinist put it in proper condition again, and it ran ten days in good style, when it had another collapse. He couldn't wait this time to have the shaft straightened and turned, said it was all right, and besides, he was way behind with his work; machinists must hurry up the boxes and get started. They were hurried through and he got started again. Well, the way that cylinder run would surprise most people. It seemed as though one particular wing on that cylinder wanted to travel in a much larger circle than all the rest, and do all the cutting; in truth, that's just what it did, and the consequence was, that the whole job had to be done over again in a proper manner. Then everything went lovely once again, *for a time.* Rushing said that delay cost him over fifty dollars, by throwing him behind on his work. This reminded me of a certain wag, who said that he had lost $10,000. On being asked how, he replied that pork had advanced $1 per barrel, and he did not have 10,000 barrels on hand. Rushing did not have the time to stop and examine his machine, and find out what was necessary, neither would he allow anyone else to do it for him. He saves so much money by not having an intelligent, careful foreman's services to pay; he doesn't need to, you see. There is not an old, good-for-nothing machine within

his territory that he knows of and doesn't long for. He is just as liable to get an old planer and make a saw table of it, or to convert a tenoner into a moulding machine, as anything else.

I saw a gang rip saw that he had made from an old, wheezy planing machine (wooden frame) that might have come out of Noah's ark. He paid for it about two-thirds as much as the price of a new improved machine, and then added to, cut off, and into it, until ultimately it made a very good machine for the purpose, but he could have bought a first-class machine, with all the modern improvements, and had $150 more to his credit at the bank.

However, he would rather have a machine of his own design, and hates to see old machines rust for lack of occupation. I think one couldn't persuade him to purchase a new machine because it might get ahead of his time and knowledge. I believe that if he had a year's work for a machine to dress 6x6 or 8x8 inch stock on all four sides, he would probably buy a pony planer that would dress one side at a time, and that he could carry under his arm, or that he dare not attach a shaving pipe to for fear that the exhaust fan would draw it up the "spout." Labor is cheap and he would have a great deal more work to do. He generally has on hand, stowed away in various places, more odds and ends than would put to blush a good, flush scrap heap, or junk shop, and when an extra counter-shaft, pulley, or bearing is required, can fish out something every time that will be made to answer after a fashion, when it has cost infinitely more than a new piece, which would be right. His superfluous trash never gives out because he adds to it by degrees faster than he uses it up. It may be there is money in this heap, but I think there is not much profit extracted from it.

Rushing generally pays his bills and accounts with notes at three months, with use, and at their maturity gives a check for one-half and renews the balance—says "business is good, in fact it is 'rushing,' but collections are slow." He pays interest enough every year to support a family easily. His creditors and the commercial agencies say: "He is honest and industrious, and economical in his living, but is not believed to be making much money—pays his bills rather slowly."

I have known Rushing for the last twenty years, and he has been in business steadily all that time, and is actually worth less than when he had done business for about two years. He never sees the time that he is not wearing out shoe leather trying to get the shekels to make both ends meet.

Now it may be that Rushing is happy in his way of doing business, and merely continues at it for fun, but certainly there are no "millions in it" for him, and there are other men in the same line of business that do not work or worry half as much, yet make a comfórtable living, and lay away some money every year. I have considered this matter a little, and think it barely possible that Rushing might do better were he to divide his labor with an intelligent foreman at a good salary, who would organize his shop affairs so that it would run on a good system; pay him for that particular kind of work; simplify and cheapen methods of production, and always have machines ready for any class of work for which they are adapted. Then he could take the office work and collect promptly, as well as pay promptly, and consequently with less money. His work would soon show a much larger margin of profit, and he would do more of it.

Of course the belt maker, machinist, steam fitter, etc., would have less to do, but that is their lookout, and besides, he would take life much easier, and greet his creditors with a smile instead of a growl when they called on him. In a word, he would find that a sub-division of labor, properly organized and systematized, would be a good thing for all concerned.

CHAPTER X.

THE LOCATING OF MACHINERY—ADVANTAGE OF HAVING SYSTEM—MULES THAT DON'T KICK—BELT CARRIERS.

OF the many people who purchase machines, there seem to be but few who give much thought to the matter of locating them. They will perchance cast their eyes to the line shaft, and see where they can most easily take out a length, put on a pulley to drive the machine in question, re-couple the shaft, place the belts and start up the machine; or they may select some part of the floor that has the most open space, forgetting all other considerations, and place the machine there. Again, others want a machine to stand at right angles to the line shaft, but not knowing how to lead the belts to the machine, give it up and do what they consider to be the next best thing, which may be entirely unsuited for the purpose intended. In either of these cases, as well as many others, the machines are a continual source of delay and trouble, costing a great deal more time and money to operate them as well as to get work to and from them.

I have seen a buzz or hand planer placed in the darkest corner of a shop, requiring a gas light almost all the time; I have also seen upright shapers so close to a wall that one-half of their work had to be done on the next one, thereby causing delay and extra cost of production. Again, I have known of large planing and matching machines so placed that all the lumber that passed through them had to be handled at least twice as much as it would have been if a little consideration and study had been done on the start.

A great part of the success of some establishments is largely due to the advantageous location of the various machines used therein. Light being absolutely necessary to the production of good work, it should be one of the first considerations. An illustration of this fact is had by comparing the amount of work per-

formed by a man on a machine in good, clear daylight, with that done by the same man, on the same machine, while using gas or other artificial light (electric light is not taken into consideration here). Convenience in getting stuff to and from a machine is another important item. No machine that is tucked away in a corner, or has its surroundings of such a nature that extra exertion and work have to be employed to supply it, can do justice to its maker, operator, or owner; the machine may possibly do as much work but it will be at an extra expense.

Another important feature to be considered in locating a machine is that it should have plenty of room. It is neither pleasant nor profitable to have a saw table and buzz planer so close together that every time either operator steps back with his work he is compelled to climb upon the other's back, neither is it just the thing to have a board running through a rip-sawing machine strike the mortising operator in the back, until he wishes the saw was at least three or four feet away in his rear. You see there is a good deal of backing to my arguments in favor of ample room. Why, I would give them plenty of room if only for the same reason that Mark Twain invented his scrap book, viz.: to save barrels of profanity.

Finally, a lot of machines should be so placed in relation to one another, that no piece of work would have to pass a machine without being operated on, if necessary. It is poor policy to have a machine operator have to pass his work clear to the other end of the shop for the next process, and then back to the middle of the shop, and so on through all the processes. I have in my eye an establishment that took lumber in at one end and brought the finished work out at the same door, and I can truthfully say that each piece that was cut up as it entered was carried up and down the whole length of the shop at least three times, and that, too, when there was not the least reason for so doing, as there was plenty of room and light everywhere. I said there was no reason for it; there was: the owner's lack of studying and reasoning faculties when he started, and they have developed nothing better yet. After the stuff was sawn into lengths and widths, it would run against a boring machine, around a sandpapering machine, and under an upright shaper to reach the planer, when planed it would go through a like devious path to reach the buzz planer, and so on until it was taken to the finishing room. How they managed there I don't know, as I was glad to get out of the machine room, and considered that I had accom-

plished quite a feat with my big feet. It is needless to say that other concerns in the same line of business do not fear the competition in trade of such a shop as the one just mentioned. They have no need to; such shops are generally as untidy and wasteful as they are inconvenient. System is one of the fundamental principles of success, and is nowhere more clearly shown than in the locating of machinery.

In contra-distinction to the above class of shops, I would say that it gave me great pleasure to go through a large furniture factory not long since, upon the invitation of the superintendent, with whom I am well acquainted, and know that his great hobby is system. The machinery was so arranged that the lumber went in at one end and door, and out the other, almost as quickly as the boy who went through college in the same manner, with this difference, the lumber showed the results of "going through" by being a finished piece of work. It first went to the cut-off saw, thence to the ripping saw, then through the planing machine, afterwards to the jointing machine, band saw, scroll saw, or sand-papering machine, as occasion demanded, but no unnecessary steps were taken, and there was no going back. Once started it went like clock-work, smoothly and without friction. The same organized system extended, as a matter of course, to all the different departments, and I can assure you that any visitor to that factory will be favorably impressed with the *modus operandi*, no matter if he doesn't know a tenoning machine from a corn sheller. He will leave the premises with the impression that the brain having in charge the mechanical part of the works, understands the value of a *system* of locating machinery.

Not long since the writer had a part in supplying a factory that had been run on the good old hap-hazard plan, with some new machinery as it was being enlarged. An efficient mechanic who makes such things his special business, was employed to arrange and set the new works.

Looking the situation over carefully, he began to dispose of the different machines in such a manner that they would be placed where they would do the most good, but after about two-thirds had been so arranged the owner came into the building and the new order of things was so entirely at variance with the old, that he ordered them changed. Expostulations and explanations were in vain: he must have them something like what they had been for the past fifteen years. The expert would not submit and he left. Well the machines were all re-arranged and two of them

were so close together that the men could not work, and Mr. Owner ordered two feet to be *sawn* off a rip saw table before he would acknowledge his error, it then had to be moved and patched up before it could be used at all. Not long since this same factory caught fire by reason of their not having the exhaust fan properly put up, entailing a loss of several thousand dollars. This severe loss was caused by ignorance and obstinacy: hard words but true.

Machines are often required to be placed at right angles, or even at any angle to the line shaft for a matter of convenience, etc. This can easily be performed with the aid of a "mule pulley stand," a mechanical device but *little* known. It is far better for all ordinary purposes than bevel gears, and can be used to transmit power to almost any angle within the same plane or nearly so. It consists of a standard or column suspended from the ceiling at any point suitable to turn the belt. It is provided with two idle pulleys revolving on stems which are adjustable in any direction; it receives the belt from the line shaft and turns it round the corner to the countershaft at any angle; it is simple, reliable and noiseless and promises to take the place of many bevel gears. The first cost is much less than that of gears and it is easily put up by anyone.

Belt carriers are also a useful appliance for the transmission of power from one side of the shop to the other. They can be placed midway between the delivering and receiving point, and hold the belt up out of the way—in other words, take up all unnecessary "sag." They are made with a column hanging down from the ceiling and have two pulleys for upper and lower side of the belt revolving on spindles at right angles to the column or stand; they are also adjustable in any direction, thereby allowing the leading or direction of a belt, and they also save a long belt from excessive strain.

Indeed mechanical appliances for transmitting power in any direction are so numerous and varied, that with a little good judgment there is no valid reason why the art of setting up and locating machinery should not be thoroughly executed and machines conveniently arranged.

CHAPTER XI.

GREEN STARTS IN BUSINESS—GOES THROUGH A FIRE—TAKES IN TWO PARTNERS—TOGETHER THEY MAKE A SUCCESS OF THE BUSINESS.

J. F. GREEN is an old acquaintance who commenced business as a box manufacturer in a small way years ago. He started with a very meagre capital; rented a room in a good locality in a large city; bought a pony planer, box board (hand) matcher and saw table; rented power from his neighbor, and hired a first-class man whom I will call Peter, to look after his machines and run them, with the assistance of one man and a boy. Green did not pretend to overflow with wisdom regarding the different kinds of wood-working machines or other supplies, but soon ascertained from some of his friends just what were the requirements of those special tools of which he was in need.

Acting on this information, he made judicious purchases and commenced business. He had had considerable experience in buying and selling lumber and keeping books, and was a keen judge of the demands of the market and of human nature in general. He did a little of everything about the establishment but operating the machinery, solicited custom, made collections, bought lumber, and even delivered his goods sometimes with a hand cart driven and hauled by himself. He was prompt, reliable, reasonable in prices, made superior work, paid his little bills in "spot" cash, and in a few years had, by additions from time to time, increased his trade so much that he was compelled to seek larger rooms. He finally concluded after an extended conversation with Beachwood & Co., proprietors of a large lumber yard, to buy a lot near their yard and erect a building large enough to do an extensive planing mill business in addition to his box factory.

He bought two more planing and matching machines, a re-sawing and a ripping machine,etc.; paid for engine and machines in cash and paid Beachwood & Co. in work for the lumber used in the construction of his building. His foreman, Peter, was by this time

kept so busy looking after the machines that he did not have time to do anything but adjust and keep them in order, file saws, sharpen cutters, etc. Peter said he must have a tool room fitted up—nothing extravagant, but a place to "keep things" in and know where to find them. Green saw the point and accordingly a room was partitioned off, and a vise, bench, automatic grinding machine, grindstone and all the tools necessary to supply Peter's various wants were duly installed in place. He had extra saws, knives, matcher heads, cutters, etc., on hand and saw that every machine ran from starting to stopping time excepting the delay for oiling and changing which takes but little time.

Green also found that the business had expanded so that he secured the services of a smart young man to look after his office and keep the books. He believed in insurance as a means of saving grace, and consequently got his entire plant insured.

Business went on swimmingly for about two years when one noon there was a sudden cry of "Fire!" The flames did their work so thoroughly that nothing was left to indicate what had been located there, but some old machines burnt beyond all recognition even by their builders.

Most men would have been discouraged by such a severe loss, cleaning out everything but a small homestead, but Green was not *burnt* any himself, and he had all his old energy, pluck, perseverance and good judgment left, besides a fair amount of insurance. So he told Peter to get the men together and informed them that they would not lose a day's time; set them to work cleaning off the wreck; put up another larger and better building; bought machinery, shafting, and everything needed for another trial, and commenced to ship boxes and lumber in forty-five days from date of fire. The new mill was made of ample size to greatly increase the amount of business anticipated, as times were then on the turn for the better. After everything was fairly settled, Peter and the book-keeper—whom I forgot to introduce as John—were invited to come down to the office one evening where Green told them how well pleased he was with them and that henceforth he would give each one a certain percentage of the net profits of the business. He wanted them to consider themselves to all intents and purposes partners in the concern, and if it was found necessary to add any new machinery for an increased production of work, such an item would not be figured in as running expenses, but that all cutters, saws, belts and repairs were to be so considered. Of course Peter and John were highly pleased at the thought of

receiving a share of the profits in addition to their salaries, which were already liberal, and so expressed themselves to Green and assured him that they thought they could do considerable to increase and cheapen the production.

Business finally became so heavy that Peter had to cease all work in the tool room and give his whole attention to the management of the factory or mill with its sixty hands, so he employed a good, intelligent man, whose sole business was to keep all the various tools in order and report where any particular one was becoming worn so much that it would soon have to be duplicated. Then Peter would hand a memorandum to John and the result was that duplicates would be on hand before they were needed. All supply agents were turned over to Peter as Green did not pretend to know much about such matters. John likewise attended to all the office supplies, printing, etc., while Green himself found that his whole business consisted in buying and selling. He could be away in the great lumber districts for weeks at a time knowing that his business would not suffer in his absence, and that John and Peter were looking after his interests as well as though he were home.

Careful and sharp as Peter and John had been previous to their admittance as partners, they were very agreeably surprised at the end of the first year to note the increased percentage of profit. Green had made more money by a great deal, and both Peter and John had what would make a handsome salary extra in addition to their regular wages.

Now the secret of this success was that Green knew his abilities and did not forget his *disabilities.* He was well aware that he could buy and sell and generally manage his business successfully, but was also fully aware that he had not the knowledge or time to do everything and do it all well. His good judgment enabled him to gather around him good assistants in their several specialties to systematize and divide the labor so that it could be thoroughly and easily performed without the large amount of wastage that would surely result if not properly attended to. The consequence is that John can easily tell at a moment's notice just how every account stands on the books; orders all the cars, attends to the shipping; keeps a list of the amount of lumber and the number and size of nails for each different size of box, and the cost thereof; knows how much lumber passes through the mill each day—in fact can promptly inform Green regarding any matter under his immediate charge.

Peter knows just how much the expenses are from day to day for supplies, repairs, etc; looks after them, and sees that every detail is always ready; examines each machine and its work; frequently gives advice to the man in the tool room and the operatives regarding their work; and personally looks after the smallest matter under his supervision as well as though it were his own; while Green is doing all his "running around on business" with a good horse and buggy.

Every person about the place, even to the small boy, has an incentive to do the best he can. I have been in several mills in my time and do not hesitate to affirm that there is not a more careful, economical, earnest and contented set of workingmen to be found in the country. Each one is interested in producing as much and as good work as possible. Every modern improvement is to be found in Green's mill that tends to cheapen and increase production. Money is spent almost lavishly in that direction but each machine and operator has a particular duty and fulfills it. There is no clashing or cross pulling, everything works to a harmonious system, even to cleaning up the machines and mill every night when the whistle blows.

All the machines were purchased with particular reference to what was required of them. The best to be had were bought—no second hand machinery, for Peter argued that generally what was thrown aside was not just the best. Neither would he have a combination machine to do many kinds of work. He believed that the more simple, convenient, and easy they were to adjust and operate, the better they answered his purpose, and besides each machine was kept busy at one particular run of work.

I have an opinion that there are not many shops employing seventy-five men and boys that show so neat, orderly, and even tasty appearance as Green's, and I know that it is a successful one.

CHAPTER XII.

BELTS; NARROW, WIDE, SHORT AND LONG—MILES OF BELTING—OBSERVER IS "BELTED."

I WAS recently called to the furniture factory of Eastlake & Co. to supply them with belting for a new machine, and during a conversation with the superintendent, he said to me, "our belting costs us considerable every year, as we use miles of it." Of course I was aware that they used a large quantity of belting, but the idea of summing up the whole in *miles* had never occurred to me. However, when I think the matter over I conclude that it is a small mill that has not at least a mile in use.

The fact is, that no one using machinery of any kind can do without it. It is an all important factor in the problem of transmitting power, but as it is only what might properly be termed an attachment to the machine it drives, it receives very little consideration and care from the user. Some mills and factories have almost miles of belting thrown aside in some old boxes or barrels, rendered useless through various causes, among which are carelessness, neglect, too hard work, and being too short or too narrow for their various places. All these results arise either from inattention to, or lack of knowledge of, belting, its capacity, strength, etc., as well as the care it should receive.

John Smith is determined to have belts wide enough, and doesn't care for anything else; Joe Brown wants a wide belt, and loses sight of its length; Dick Roe puts on an 8-inch belt to drive a small saw; and George Lee will start up the largest flooring machine with a 6-inch belt. None of them are right, and common sense will prove it even if "old Bill Jones is dead."

I once ordered a 9-inch belt from one of the best belt makers in the country, at a customer's request, not knowing what he required of it. Mr. Customer came along about six weeks after, and said, "I don't want any more of that kind of belting. Out of the forty-five feet I have cut almost seven feet, it stretched

so." I said "Impossible! What planer are you driving with it?" "What planer? Why, all the planers. That is my engine belt." Now, he had just put in a large flooring machine driven by an 8-inch belt; a large surfacer driven by a 6-inch belt; a large re-saw driven by an 8-inch belt; a rip-saw driven by a 5-inch belt; and a moulder, mortiser, tenoner and other machines. Poor 9-inch belt, only 1-inch wider than the planer and matcher belt, had at least four times as much to do, and was doing at least the work of a 16-inch belt. The only wonder was that he got any power from it all. He would not if he had not got a *first-class* belt, made upon honor.

A belt must not be taxed so heavily to do its work as to stretch very much. If it continues to do so, rest assured that you are using either too narrow or too short a belt—perhaps both. Now, as speeds average about the same on kindred machines, it should be a comparatively easy matter to have these belts produce good results in transmitting power, wearing well, and lasting long.

In setting up that rip-saw of yours, locate it so that you can have at least ten feet from the center of the driven to the center of the driving pulley, and do not have the belt exactly perpendicular, as that causes a belt, when a little slack, to hang loose on the lower pulley, and decreases its usefulness. Put on at least a 5-inch belt, and if you have much heavy stuff make it six inches. Fasten the ends after you have cut them square, with good studs, hooks, or lacing, and put the grain or smooth side next the pulley. It will last one-third longer, and do better work. After this belt has been run a short time, say one week, moisten the smooth side with some good belt preservative, and give it more as often as it gets hard and dry. If it gets greasy or dirty after long usage, wash it thoroughly with warm water, and then give it a good stuffing of warm tallow and neatsfoot oil, and you will have a belt that will give you good satisfaction and wear, while costing but little for repairs.

Another thing I want to say right here—don't go out of the mill at night without throwing the belts off from the pulleys. Give them a rest at night as well as yourself, and see how they will "brace up" for business in the morning. They will not be strained or stretched all night. If I had a mill with a thousand belts I should insist on having them all taken off the pulleys, if possible, every night.

When you get to the planer, if it is the average-sized flooring machine or large surfacer, put on an 8-inch belt about twelve

feet from center to center of shafts, and for the cylinder and matcher belts, be sure to select only the best, as they travel, on an average, about 4,500 feet per minute. They must be strong, well jointed, pliable, and not too heavy to give good contact or adhesion to the small pulleys on which they travel. I presume that no belts in the mill have as hard work to do as the matcher belts on a flooring machine. They run fast, get little care, are quarter twisted, and run over small pulleys, and very often do heavy cutting. They are short lived at the best, like all things else in the mill, from the "fast" life they lead, and should therefore be carefully selected.

In setting up your re-saw, if it is a 42-inch, put on an 8-inch belt at least twelve feet from center to center of shafts, and so on all through your mill. Don't get too short or narrow belts. You are more in need of caution in that direction than in the opposite, viz., too long or wide, although the latter can also be carried to a wasteful excess.

Avoid half-twist, (or cross,) or quarter-twist belts. Keep them well jointed, soft and pliable, as well as clean, and you will not have such a large item in the expense account to be charged to belting.

Buy only oak tanned, short lap, first quality belt in all cases for wood working machinery where you use leather belts. There are some good rawhide belts on the market that are preferable in some respects to leather belts, being as strong, lighter, very pliable, wrapping around small pulleys very easily. I have seen it used with good results in many cases. In some climates nothing seems to stand as well as rubber. It is cheaper, but on the whole does not last as long, and when once started on the down track goes very fast. Thus far, leather has given the best general satisfaction.

See that your belts are straight on their edges, and of equal thickness; have them of ample width to perform their duty easily, and they will wear much longer. In placing them, they should be cut square or at right angles to their edges, and thus avoid "crooks" in the belt, and if lacing be used, cut the holes oblong and parallel with the length of it, to preserve strength. In putting belts together, be careful to have the laps *run with* and not against the pulleys; always run the grain side next the pulley and it will last much longer; never cut the slack or "sag" out so long as the belts do their work easily, unless they run in heavy contact with the lower half. High speed belts are apt to do con-

siderable damage if strained so tight that they tear apart, as I know by experience.

I was superintending the testing of a planing machine some time since, and went away after setting a man to putting the belts on. Upon my return I found that the machine had just been started. Hearing one of the belts "whip" a little, I concluded to examine matters before going farther. As I made the first step aside, one of the cylinder belts, four inches wide, traveling 4,600 feet per minnte, parted and struck me. I had no ambition to hang around or do much for a while, but when I came to I thanked the men who had cared for me, and *blessed* the one who had stretched that belt and caused such a result.

I have in my mind a twelve-inch double belt, less than nine feet between centers, running on upright pulleys that travels at a speed of 4,200 feet per minute, and has to be replaced about every six months. It transmits fifty horse-power, and must be kept pretty tight and accurately balanced. If it should tear out, the utmost care has to be taken to splice in a new piece just the proper thickness and weight, otherwise the balance would be destroyed. The shafts can not be moved farther apart, neither can the pulleys be changed, the driving one being only twelve inches in diameter, and the driven one fifty-two inches. A great deal of trouble was had at first from having the binder pulley close to the driven, as the belt would run off every once in a while. I suggested placing the binder close to the large *receiving* pulley, and when the change was made, all trouble from that source ceased. I know that this is different from the general theory, but the tightener or binder *led the belt* on and kept it there.

All belts, and particularly those in planing mills or similar places, should be well "stuffed" or at least coated on the pulley side with a good belt preservative, consisting of a mixture of tallow and neatsfoot oil, equal parts, applied while warm. This can be done occasionally with a good deal of comfort and profit to both user and owner. It saves the belt, causes it to become more pliable, and consequently perform its work more easily. This little job is particularly necessary in a wood-working factory, where belts become so dusty and dry.

CHAPTER XIII.

A BREEZE AMONG EXHAUST FANS—PROPER SIZE AND CURVE OF PIPES—LOVELY'S BIG FAN.

IN speaking of fans, I don't want you to think that I mean the kind by which ladies waft gentle breezes to cool their æsthetic brows, or to carry on a flirtation at a ball or concert. No sir! not I. What I do mean is the exhaust fan which, with its seductive draft, entices the shavings and dust from your planing mill. These machines have their uses and abuses.

I ordered an exhaust fan for a certain mill not long ago, of abundant capacity for the work required, viz: to take away shavings and dust from a large flooring machine, a surfacer, re-sawing machine, and two saw tables. Went to the mill and made diagrams and data to get speed, location, size and shapes, and left them with the builder of the mill. When the fan was put in operation, I was informed that the thing was a failure, no good, would not answer at all, etc. Putting a pencil and speed indicator in my pocket, I started for the mill, looked over the ground and found the pipes, curves, etc., all right, but when the speed was indicated, the fan was running about 600 revolutions per minute too slow. Of course the fan would draw but very little. Any "sucker" (pardon vulgarity) could have seen that.

The speed was made all right, and the fan cleaned up everything that came near the pipe opening, even to a heavy slouch hat, and that was *slightly* damaged when the owner found it in the shavings room, 225 feet away from the fan.

Another case was that of a man owning a planing mill, who put up a large fan some years ago and "took suction" from two large planers, one re-saw, and three saw tables, in good style. This summer he put in a large new planer, located all his machines differently, and thought he would do a nice thing in the pipe business. So he took down the old square pipe, and put up a round one of the same diameter. The old square one was

none too large in the first place, and this was reducing his pipe area one-fourth, and adding another large machine, and to cap the climax, he entered two of the branch pipes at exactly right angles to the air current.

He came to me and said he guessed he would have to get another fan; that he had put plenty of curve to the branch pipe, but still it failed to work. Investigation showed affairs as stated, and after consideration, I came to the conclusion that his main pipe was too small, and his branch pipes not curved in the *proper* direction. I advised him to put in a second main pipe above the old one, and to give it a gradual curve or pitch to the fan entrance, and attach his branches in the proper manner. Those two machines are kept freer from shavings and dust than the rest.

Messrs. Lovely & Co. were building a model box factory, and bought new engines, boilers, shafting, belting, and planing, sawing and other machines, all the best that could be found. They were determined to have a clean as well as a model factory. The specifications and drawings for the building were approved by the insurance company, in order to secure the lowest possible insurance rates, and as a consequence, the factory had to be kept clear of shavings.

Lovely came to me to talk about exhaust fans and pipes, and knowing just what machines he had, I sat down and made a few figures for him, regarding the proper size of pipes and fan. He had a sheet-iron worker follow out my suggestions in getting up the pipes, and I had the exhaust fan shipped to him.

In due course of time Lovely called and said that his fan had arrived, but he was afraid it was too large. I argued that it was none too large, and that he had better try it before condemning it. I could see when he went away that he was not thoroughly satisfied. In a few days he came around again and said that the fan grew larger in his mind, and he wished I would order one of about two-thirds the capacity. I immediately wrote a letter ordering a smaller one, but before mailing it, asked him to go to the factory with me, and we could decide better there. After I had figured the area of each pipe for every machine, I soon convinced him that in the first place he had pipes that were ample and not extravagantly large, and that their combined areas were little more than the area of the inlet. This settled the question, and the fan was put into use, and the result was, that it cleaned the refuse from every machine quite easily, and Lovely is better satisfied with it every day. He had some large saws cutting heavy

stock, making plenty of green, wet saw-dust, which is a great deal worse than any shavings made, and requires a good strong suction to draw them away. I could many more tales unfold, but forbear.

To make a success of exhaust fans in a planing mill is simple enough, if you will only stop to reason and follow directions. In the first place, give a fan the proper speed as per the maker's directions; locate it as centrally as possible for all the machines; give the branches long easy curves, and in the direction of the current; put stop-gates in each branch to close when not in use; make the hoods or covers to the machines as close a fit as possible; do not have the combined area of branch pipes any greater than the area of main pipe, and have the main pipe as large as the area of the inlet to fan. Have the outlet pipe the same size as fan outlet, unless you have to drive the shavings a long distance, in which case you will have to reduce size somewhat to get force of air-current for the case. An exhaust fan should always be put in with reference to the extra amount of work it will have to perform by the constant adding of new machines from time to time. If you get a fan somewhat large at first, you can slow the speed and keep increasing it as machines are added, until the maximum speed is attained.

In making pipes of wood, first plane the stuff at least on the inside, to make a smooth surface, which increases the efficiency by not having any obstructions for shavings, etc., to catch on and clog the pipes. It would also be a good plan to fill the two lower corners of a square pipe with bevel pieces, to avoid square corners, for the volocity of wind seems to be less in the corners, and may sometimes allow refuse to accumulate and finally fill the pipe. If one cares to go to the expense, a much better job could be had by lining the inside of the whole pipe with light sheet-iron. Heavier iron should be used for the curves, and these curves should never be contracted in size. If any difference is made, it should be in the other direction.

In making hoods or covers for cutter heads, the best plan is to have a sheet-iron worker take measurements and fit a hood, having a gradual taper reaching the size of pipe about two feet from the base of hood or cover. Attach to it one length of pipe that is small enough to telescope inside the length just above; fasten two handles in the hood, and attach cords running over a small sheave above, with weights sufficient to balance the weight of the hood. You will then have a good cover that is easily handled and always ready for business.

CHAPTER XIV.

HOW SOME SAW TABLES ARE MADE—RUSSELL TRIES HIS HAND AT THE BUSINESS, AND DISCOVERS "HOW NOT TO DO IT"—A FEW HINTS REGARDING A GOOD ONE.

DROPPING into Russell's mill the other day, I observed a new saw-table which had just been fitted up and had bolts put on. I examined it, flattering myself that I knew how to pick flaws with other people's work, even if I didn't know how to better it. Upon investigation I found that times were a little "slack" in the mill, and the folks after sending for circulars and prices all over this broad land, thought they could just beat anything they had seen for adaptation to their business as well as their pockets, (especially the latter.) Russell told the boys in the mill to get a frame about so long, wide, and high, out of the best hard wood in the yard, and when they got done he would go to town and see if "Jones & Co.," or "Smith & Son," had any saw arbors, gauges, etc., on hand. If they had, he would have them shipped home and fit them on. Well, when he gets through the different shops, he is surprised to find that there are no saw-arbors about anything like the kind he wants, to be had. Neither can he find patterns to suit him, so he comes to the conclusion that either one of two things is to be done, viz.: take what he can get, or have something made to order, entailing new patterns, etc., at a larger increase of regular cost. He finally chooses the former.

They arrive in due time; he tries the arbor on the frame, finds lugs on boxes are not such that he can bolt them down to his frame; guides too large or short, wide or narrow; pulley on saw-arbor too long or small for line shaft pulleys. He studies and thinks, and looks first at the frame and then at the iron work, until finally it begins to dawn on his mind that *his* business is running a lumber yard and planing mill, and not a machine shop, particularly a shop where a specialty of saw-tables, benches, and "sich" are manufactured. But after a time the thing is finished, and no one around the establishment seems to go into ecstacies

over it. Oh no! It has few points to be admired, and many to be condemned. The frame is out of proportion, and had to be patched out to suit some other part. The arbor is out of alignment, and not properly bedded on the frame; it will not saw easy or clean, but will heat both saw and boxes; the gauges are not square, nor have they proper clearance at the back of the saw, and reach too far behind, binding the lumber and also wasting it because not cutting a straight line; speed is not right for size of saw, and so on *ad libitum.*

Now reader, don't "sit down" on this saw, because if you do, you might not get up to look at one that would suit you better. Right here I wish to state that in mills, saw tables can be, and are built with wood frames that are all right and in every sense a perfect success, but to each one of this kind you can find hundreds that are far from it.

Go to some reputable wood-working machine manufactory, or a dozen if you will, and select the machine built for the purpose and wants of the trade. Then subtract the cost of the one you build at home, including lumber, timber, and other materials, and your men's time, and I will guarantee the balance in your favor will not endow a college very heavily. I know it will not compensate you for all the trouble and time you have spent over it, not speaking of the annoyance it will cost you as long as it is in the mill. Some iron frame machines are as big a nuisance and trouble as the poorest wooden frame I ever saw. The frames seem to be designed especially to see how light and fragile they can be made; have very short boxes lined with cheap Babbitt metal; iron arbors; small pulleys with narrow face; wooden tops or table, poorly made and hung; no adjustment to any of their parts, and really are not worth the freight bill to transport them to the mill. I once knew a man who had bought one of these "apologies" for a saw table because he got it for a small amount of money; put it in his shop; tried to use it; couldn't do it; took it apart and carried about half of it to a machine shop; had bearings turned up, gauges squared, etc., and started again. The machinist who did his work had a bill of items against that saw the first year, which if added to the first cost would have purchased a good first-class machine, and the old trap wasn't worth shop-room after all the doctoring. Now the machinist was not to blame. There was no vitality, no lungs, so to speak, the disease had gone too far, and besides it was not very healthy to begin with. A good saw table or bench for slitting or cross-cutting is a very

simple machine, yet has a few vital points, that must be right to be a success, and be also susceptible of some means of adjustment In the first place, the frame should be strong and heavy enough to insure it against vibration; the table should be iron, accurately planed and made to the frame; the saw arbor of good steel, ample size, running in bearings lined with the very best Babbitt metal; the boxes cast together on a frame to hold them in line, and fitted nicely on guides so that the saw can be raised and lowered quickly and easily by a crank or other suitable device. The pulley should be at least one-third the diameter of the saw to be used and fully as wide; the collars should be faced true and a little concave toward the center; if there is not room for a collar one bearing can be grooved to prevent end play or chase.

For a mill or factory where the business done demands only one table, it should have two gauges or "fences." The cross-cutting gauge should be made to cross-cut square, or at any angle up to 45 degrees, and be provided with a tongue or guide fitted in the table to slide easily and perfectly. The slitting-gauge should be so constructed that it will cut beveling back to 45 degrees; should be located so that its rear end does not reach beyond the center of the saw; fitted to slide to and from the saw quickly, and finally have an adjustment to enable the operator to ease the rear end from the saw when from any cause the lumber has a tendency to hug or pinch the same. It can also have another valuable attachment, viz., a long shaft and index wheel to indicate width. When used extensively for slitting, this enables the operator to set his gauge without going up to the saw table, and as soon as he picks up his board. Some folks have used packing or "steady" boxes for saw tables with very good results. They could use thinner saws, and consequently save labor and power in cutting and economize considerably in lumber. These boxes are secured on the under side of the table and are packed firmly with hemp or other suitable material and kept well lubricated. They are provided with an adjustment to take up wear. They are not practicable, however, where saws are carried up and down to any extent. To be of any use they should be near the periphery of the saw, hence would be cut by it if raised or lowered to any great extent.

For mills that do enough matching to keep even one good, fast flooring machine running steadily, I should say get a power feed gang edging saw. You will cut three times as fast and not have walked one-tenth the distance during the day.

CHAPTER XV.

A CHAT ON SAW ARBORS—THE DIFFERENT KINDS —THE ADVANTAGES AND DISADVANTAGES OF EACH—HOW TO MAKE A GOOD ONE.

MY attention has been called quite frequently to saw arbors of various kinds, and I will give a few of the impressions received as the results of observation and experience. Saw arbors are made in many ways and shapes, but for all practical purposes can be divided into three general classes.

The first is a plain arbor fitted in two separate boxes or bearings independent of each other and secured to the frame by bolts, with the pulley either between the bearings or at the extreme end of the arbor. The second kind is made by connecting the boxes so that both boxes and connection are all in one casting, having the pulley outside. The third and last is similar to the second, with this difference—the connection holding the two boxes together is designed to receive the pulley in the center. Each and all of these can have either plain or self-oiling boxes. There are objections to all of them, and after noting them you can pay your money and take your choice.

The first named, or independent-box kind, may be never so well designed and constructed for high speed and severe duty, but it is very difficult to place on the frames perfectly in line and level, because the slightest warp or twist in the timbers, which may not be apparent or discovered, will spring or "cramp" the bearings enough to cause them to "heat" and call for tallow and the oil-can quite frequently, until it is finally condemned or has the bearing re-lined or re-babbitted.

The second kind is free from the above objections because they can be placed on the frames together, "in line and level," without any difficulty, and should be made heavy enough to resist any tendency to spring under the strain of any ordinary bolt by which they are secured.

You also have the advantage of using paper or paste board packing *ad libitum*, but, when you come to run that arbor and find a belt tugging away at one bearing and the strain so unevenly divided, you will invariably find that the bearing next the pulley will wear out three times as fast as the one on the opposite end. I have re-babbitted scores of them and I speak by the card.

The reason of this is plainly seen. The bearing is being continually strained or pulled towards the driving pulley by the belt. The bearing on the saw end has nothing to do while the saw is running empty, whereas the belt strain is always on the other bearing, and when the saw is working at full capacity, the duty of one does not increase any more than the other. The third kind is my style. I want the bearings connected and the pulley in the center every time, if it can possibly be so arranged. I then get an even distribution of work or duty on both sides, and have less repairs and trouble.

Now perhaps a great many will like to know why a saw arbor, originally well made, giving good satisfaction, and little trouble for a long time, never does so well after being re-babbitted at the mill or in some "slop-shop." It is simply for this reason; no arbor or spindle should be used for a re-babbitting arbor or mandrel, unless it is put in a lathe and carefully trued up and made round if necessary, as the chances are ninety-nine out of a hundred that the hot babbitt will spring the steel arbor.

A great deal of trouble with saw arbors arises from the fact that they are made of too slight proportions, or that the purchaser gets them too light for the purpose. I have seen arbors of 1¼ inches diameter at the largest place, carrying a 16 and 18-inch saw through two-inch hemlock, and others of 1½ inch wrought iron performing the same duty with loose, cranky boxes, small diameter, narrow-faced pulleys and short belts. The man worked hard, but did not accomplish much. A good, sharp buck-saw would have been as effective. A rig of that kind will eat up more money in a short time than would buy two new arbors of the A No. 1 kind, not to mention the loss of the lower end of the vest and "belly band" of trousers, by extraordinary pressure on said parts. You need never be afraid of getting too strong an arbor, or two large a bearing or pulley, for the larger these items are, the more easily the saw will do the work, requiring less power and costing less for belting, oiling, repairing, etc.

Regarding self-oiling boxes, I am no friend of them on general principles, for reasons before mentioned, but it seems almost im-

possible to do without them in some cases and especially on saw arbors.

Saw tables are from necessity built over the arbor, and must be so designed as to allow the saw to cut as near the full rated depth as possible, hence, space between the top of the table and center of the arbor must be economized as much as possible. This generally does not leave any room for oil or tallow cups on the top or cap of the box, consequently provision is made for oil below the arbor, to be drawn or fed to the bearing by wicking, a process that is all right when the oiler is well made, attended, and kept filled with good oil. The arbor should be taken out occasionally and the wicking examined, and if found clogged with any gummy substance, should be replaced; the oil chambers should be well rinsed out and filled with oil.

In making saw arbors I have always found the following to be the best proportions for all kinds of general work: The diameter of the arbor at the bearings and pulleys should be ⅛-inch diameter for every inch in diameter of the saw up to 12-inch saws. After that add 1-20 inch for each additional inch of saw up to an 18-inch saw, then 1-24 inch for each additional inch up to a 30-inch saw. This will give arbors 1½-inch diameter for 12-inch saws, 1¾-inch for 18-inch saws, 2-inch for 24-inch saws, and 2¼-inch for 30-inch saws. The holes for these saws should be 1¼, 1⅜, 1½, and 1¾-inch bore respectively; the bearings should be in length three times their diameter, which will be found amply sufficient, as they are so close together; the pulleys should be not less than one-third the diameter of the saws, and should have a face of ample width to carry a belt in width not less than one-third the diameter of the saw. Thus a saw 12-inches diameter should be driven by a belt not less than 4 inches wide, pulley 4 inches diameter; 18-inch saw with belt 6 inches wide, pulley 6 inches diameter; 24-inch saw with belt 8 inches wide, pulley 8 inches diameter. On the small sizes for hard work and severe duty, the proportions are none too great, and on the larger sizes they will be found ample to fulfill all requirements.

All arbors are provided with some means by which to prevent "end chase" motion of the arbor, usually by putting on collars, or cutting a series of grooves on one bearing of the arbor. The latter style prevails on most all of the smaller sizes because it takes up no extra space; but for the larger sizes I would prefer a collar for the purpose, because it obviates the necessity of cutting away the strength of the arbor, and will generally wear

better. It is poor policy to make a 2-inch arbor for heavy work, and then reduce it to 1½ inch in the grooves. You might just as well have made an arbor 1½ inch diameter at first, and left out the grooves, substituting a collar. Saw arbors should be carefully made from the best of materials for the purpose, because if not made so they will soon give their faults, as well as those of the builder, away.

The proper way is to assemble all the parts together, rough off the arbor, shrink on the fast collar and pulley, turning the arbor down to within 1-100 of the proper size with the grooves in, if so designed, and if the pulleys are to be keyed on instead of shrunk, cut the key seat in the arbor; place the arbor in the boxes, put packing under the caps ⅛-inch thick, and pour the babbitt on them. Return the arbor to the lathe, cut the thread for the nut, face off the collars slightly concave; turn the pulleys and journals to proper size, and balance carefully.

The reason why the boxes are babbitted before the arbor is reduced to a finish, is that experience has taught us the amount that babbitt metal shrinks, and to allow the machinist to babbitt without fitting up an extra mandrel with grooves to duplicate the arbor, and also to allow the arbor to be straightened and finished true after the babbitting process. If the boxes or bearings are self-oiling, the holes can be drilled and wicking put in after the babbitting process. Care must be exercised to prevent the babbitt from running into and filling up the oil chambers. This process will ensure good and successful results every time.

You may think this a simple subject to write on, but it is the simple and seemingly unimportant things around a planing or moulding mill that receive the least attention and care, if any at all. They are also the items that eat up the profits of the establishment when not carefully looked after.

CHAPTER XVI.

RE-SAWING MACHINES AND SAWYERS—VERTICAL RECIPROCATING, BAND RE-SAWING, AND CIRCULAR RE-SAWING MACHINES CONSIDERED—DIFFERENT METHODS OF FILING AND SETTING SAWS—OBSERVER PAYS FOR THE SAWYER'S BLUNDERS.

AFTER having been through several wood-working establishments one may well be surprised in noting the different kinds of re-saws used for substantially the same purpose. Of course one does not expect the details on machines of different builders to be alike, provided the same general principles are embodied in them, but in the case of re-saws, not only are the details unlike, but the principles are totally dissimilar, yet all the machines are doing the same kind of work, viz: making two or more thin boards out of one thick one. There are three kinds of these machines in use: first, the vertical reciprocating saw that is built from cellar to garret to keep it from "reciprocating" from one end of the building to the other. The saws used in this machine cut out a kerf of from 1-16 to 1-8 of an inch. It is easily taken care of and attended to, because it does not feed enough lumber through to dull the saw very fast. Its usual rate of saw travel is 400 feet per minute, one-half only being cutting travel. This is the kind of machine in which one can start a board and go fishing and then be back in time to start the second board. It is to be found in many mills, sash, door, and cabinet factories and other like places, because it was the best to be had when bought, or will waste a minimum amount of lumber in cutting, or the owner didn't have much for it to do, or possibly he didn't know of any better machine. It is a good day's work to get 1500 feet of lumber through it.

Second, the band re-sawing machine is in use in many factories where the amount of work is greater than can be done by a re-

ciprocationg saw, and when operating successfully, it takes out a very small cut or kerf, say 1-16 of an inch. It has a continuous cutting speed on the saw-blade of about 4,000 feet per minute and will cut from 5 to 25 feet of boards per minute. It is the most expensive re-sawing machine built, from the nature of its construction which calls for a large amount of metal and machinist's work. For a machine to re-saw or slit from 26 to 30 inches wide, the wheels should be about six feet diameter and the saws from 3 to 3 1-2 inches wide. Some makers claim that their limit in wide sawing is governed only by the length of the saw blade, but it has been proven time and again that they are limited by their ability to remain rigid. This condition changes to extreme elasticity the farther the wheels are apart, no matter how much strain may be upon them by weights or springs, as is often seen when cutting wide boards where the saw will enter at the right place on the top edge, come out at the right place on the bottom edge, but cut clean through the board in the middle. It will not cut fast for the above reason and also because a fast feed will "crowd" the saw back against the guides causing it to heat and upset, in which condition it is sometimes thicker than the kerf. Quite a number of these machines are being sold and used successfully, but they will not answer for fast work, neither do they save much lumber, in comparison to their rate of production, over circular saws used for the same kind of work. One thing, however, they are well calculated to do when properly constructed, and that is to cut any class of work that comes along. They will cut a picture frame back from a plank, make two or three, and even more pieces, from ordinary boards or plank, and reduce a 4-inch or as thick a plank as can be fed between the rolls, in the center or into as many pieces as are required, because the blade with the set in the teeth has clearance enough to avoid all "spreading" or friction. Thus far no circular re-saw has been able to accomplish this last result.

Third, the circular re-sawing machine is the kind found to be most popular. Its first cost, ease of operation, high speed, and fast feed, together with its adaptation for general use make it *the* machine and it will remain so until some other kind of machine can be brought forward that will not only do all these things but waste less lumber. It is continually being used at a saw speed of from 9,000 to 10,000 feet per minute, feeding from 30 to 90 feet of lumber, and as it has been improved from time to time (both machine and saw), it is now brought to that state of perfection

which enables it to compare favorably with band re-saws in the minimum amount of lumber cut at the kerf. More teeth and thinner saws are now considered the right thing in circular saws. They are also made truer and more evenly hammered and tempered, consequently they stand up to their work better.

I presume that there are as many different opinions regarding the setting and filing of re-saws for splitting siding or boards, as there are men that run them, and all are right and wrong under certain limits. John claims that there is nothing like the spring set; Bill condemns that and says, the swage or upset is the proper thing; Jake wants the teeth filed very hooking; and Ike files his as straight as a cross cut saw, while each claims that he is doing the best work in his section. Again, John wants his saw teeth very coarse and Ike must have his very fine. Each one gets his saw to suit him, and claims superiority in quantity and quality of work produced, while Jake's shows a medium, and he claims just as much as either. Bill says no sane person would use anything but a solid saw for re-sawing, while Jake contends that he can do more work and a greater variety with a segment re-saw, and they both refer you to their experience in proof of what they claim. Verily, the sawyer is a many-minded man.

I have seen men who had not much experience but a good deal of common sense, who could walk up to a re-sawing machine and turn out a large quantity of nice work without much trouble. I have seen other men of many year's experience (so called) in running re-saws get stuck on a new re-sawing machine, while an ordinary machinist would set him straight and get his machine running successfully in a short time, and I have seen work that neither could do because the machine was not built to make two thick pieces from one thin piece of lumber—in other words, the re-saw had to waste some in cutting.

I have seen re-saws doing nice work at the rate of 16 feet per minute, which were the pride of their operators, and I have also seen others cutting at the rate of 80 feet per minute, to the disgust of the lazy boy who had to pile it out of the way. Pete files and sets his saw about the shape, size and uniformity of a piece of chalk. His work never crowds any boy because he is always tinkering with the saw, and wonders what fool invented a re-saw for use in a planing mill when the boards might just as well have been cut to the required thickness at the saw mill. Now perhaps you think I consider myself *au fait* on saw setting and filing, and will instruct you in the matter, but you are mistaken, because

fewer rules seemingly hold good for sawyers and saws than for any other machine in the mill. I say *seemingly* because they will hold good if cause and effect are traced right to the core.

As to filing and setting, whichever way you adopt, keep the saw perfectly round and all the teeth alike. I would rather run a saw that is all set and filed wrong and alike, than one that is one-half right and one-half wrong. Keep the teeth all the same length, depth, shape and set, and you can be certain of one thing, viz: that the saw will run even or one way all the time. Only a short time ago, I saw one with half the teeth filed cross cut and the other half rip cut. You can imagine how it worked.

I prefer a very short set for a spring set, as it holds better, and I think cuts easier. For ordinary work I prefer a tooth spaced from 2 or 2½ inches long, about ¾ inch deep with a very little hook, as cutting easier and truer, and requiring less care than those of different sizes. For a machine to do general re-sawing including bevel siding, I want a segment saw, one made of a number of segments screwed on a large saw-flange. I will give my reasons, and I think you will agree with me.

In the first place, it being screwed on a flange with many screws it is much stiffer, and will bear more grief or abuse; being in segments it will not heat or "buckle," and if you strike a nail or hemlock knot and take out several teeth, you can replace a segment without reducing the size of the saw two or three inches; being a stiffer saw, you can use a thinner one and waste less lumber; and finally it will do all that a solid saw will, and also do work that a solid saw cannot do. The segment saws can be perfectly straight on one side, not having any flange in the way, and can be used to take a thin piece off a plank for picture-frame backs, cigar box stuff, etc., or as a saw-mill man would term it slabbing, as the thick part of the plank would run on the straight or log side of the saw, and have no spreaders to encounter. Of course you can split in the centre just as well by putting on a spreader opposite the saw-collar or flange. The machine in which such a saw is set should be heavy and strong, and fitted with good large arbor and bearings; it should have a strong, steady feed; all the rolls yielding and weighted to split uneven thickness of stock in the center; and should be arranged to have one pair of rolls to be set unyielding, to cut one side to a given thickness, and also to cut bevel siding, etc. It should have three or four ranges of feed easily changed; strong belt power; quick and easy adjustment in all its parts, and finally, good clamps to hold the

lumber from the rolls to the saw. This will prevent "stub shots." I think that a man who knows anything about a saw, and has ordinary common sense, can operate such a machine without much trouble, but he cannot do impossibilities. I have fitted up and operated many such machines with saws from 38 to 60 inches diameter, 16 gauge at the teeth, cutting only 3-32-inch kerf without any trouble, and some experts claim that they can use as thin a saw as 28 gauge. Bear in mind one thing; you must give the flange or taper side of the saw a little more set than the straight side, to prevent "running."

I once sent a 42-inch segment saw to a mill where they had previously used a solid saw, and a few days after they had set it up they telegraphed to me to come at once as they couldn't run it. I went there, looked at it, and asked what their trouble was. They said they had run 15,000 feet of pine through, and then the saw began to "run" and they couldn't use it. I filed it up and it sawed 10,000 feet more. They had forgotten that the saw had to be filed and set when dull.

In another case I shipped a 50-inch segment saw; received a telegram stating that seven or eight teeth were broken; saw was no good; would have to furnish them a new saw, etc. I went to the owner's mill and told him that I would gum the saw over and get the teeth up, and make the machine satisfy him, or else take it out. Worked at that saw twelve hours, gumming, filing, and setting. When I got it ready he ordered some dry cull hemlock brought in for trial. When brought in some of it was so bad that even he said that it could not be sawn. The worst pieces were sawn first, and in such good style, that he at once expressed himself as satisfied in every respect. He said he was away from home when the machine was set up, and was ignorant as to how the teeth were broken out.

Now at both these mills were sawyers of great experience, but "plagued little sense." The railroad fare and hotel bills, incidental to these two trips, amounted to about sixty dollars, to say nothing of time lost. Who do you suppose should have paid for them, and who did? I'll tell you, but don't give it away. The foolish fellow who was not in the least to blame paid them.

CHAPTER XVII.

AN IDEAL GANG RIPPING MACHINE.

IT is a curious fact that very often the most primitive and crude, as well as costly, processes and functions performed by machinery, are still used in their original condition by those who should be the most deeply interested in their improvement. Their very simplicity causes them to be unnoticed. Sometimes they are not required to produce any fine or finished work, or do not require any skilled labor to operate them. These facts tend to keep them in their antiquated state. This has been especially true of the process of ripping boards for flooring, ceiling and mouldings. The time was in the near past when first-class flooring machines would feed only fifty feet per minute, or two machines produce one hundred feet, and require two rip saws to get out the stuff for them, the four machines requiring eight operators to produce one hundred feet per minute of flooring. A machine has of late years come to the front which is fast crowding out the rip-saw table and is proving itself to be as profitable as any other machine in the mill. I refer to the power-feeding gang ripping machine.

The demands of the trade, together with the improved fast-feeding flooring machines, have called loudly for the change, and now there are few planing and moulding mills of any considerable size or capacity that have not at least one gang ripping machine. It takes no more power to produce the same quantity of work, and it can be run by the same number of operators as the common saw table and produce from three to four times the amount of work. To illustrate, one of these machines will keep two fast flooring machines supplied, each of the latter feeding seventy to eighty lineal feet per minute. These three machines together require six operators, making a saving of two, besides doing the work faster and better. These machines call for less traveling back and forth than an ordinary rip-saw table (man power) does in

one day. The feed rolls do the walking and save the wear and tear of the shoe leather.

There is in these machines, as in all others of a similar nature, a chance for the home mechanic to do himself proud by building one for himself. I have seen a few, however, that could not be considered objects of pride to the builder. I will notice one: the saw arbor and sliding collars were not convenient to get at or change for the different widths without stopping the machine. The saws could not be removed for sharpening without taking the whole thing apart; the feed power was badly proportioned and constructed; rolls located wrong; indexes out of sight or nearly so. The operation in this case would naturally be guessed. You can't guess wrong in this case.

I have been a careful observer of the machines manufactured by the various firms throughout the country, but submit that they evidently have not reached the same degree of perfection as that attained by other wood-working machines, notably the flooring, moulding and re-sawing machines. Some have good points that others have not, and in my view none of them have all the features combined that they should have, viz: durability, rapidity, and ease of adjustment and changing, and also simplicity of operation. I think a first-class machine should have the following ideas combined in good practical form: it should have a heavy solid frame well fitted and secured together, having the arbor boxes arranged with a vertical adjustment to provide for the wear of the saw. These boxes should be of ample length and strength to carry the arbor without a tremor. One of them should be so designed as to be readily removed without the aid of hammer, chisel, wrench, or any other tool when necessary to take off saws for filing, etc.

The saw arbor should be at least two inches in diameter, of cast steel, and fitted with a sliding spline for the purpose of driving and changing the location of the saws. The collars for holding the saws should be made a nice sliding fit on the arbor and have a round nut to be tightened or loosened with a spanier or hose wrench. Hexagonal or square nuts are liable to catch splinters, etc., and throw them at the operator. These collars should not be over 2 or 2½ inches thick, with the saw in its place, as very often narrow matching is called for. The diameter could be from 4½ to 5 inches according to the diameter of saws and collars. The saws should be straight ground, about 1½ inch from the tooth towards the center and hollowing thence to the collar edge, then

straight again to the hole. This gives all the profitable wear there is in the saw and provides a clearance, making it cut free and easy, and it also calls for less set. I have a set of saws of the above description running and save a great deal in power and care of saws, they being less liable to buckle.

The pulley on the arbor should be of sufficient face to carry a 7 or 8-inch belt. The feed works should be so designed that the rate of feed could be instantly changed from the operator's position without stopping, allowing for hard knots, bad lumber, dull saws, etc. One idle roll under the lumber and close as possible to the saw is plenty for feeding on side. For the pulling out or de livering side the under roll should be a live or driven one and the top a large roll that could be raised by a foot lever and not by any method requiring the use of the hands, as the operator has enough use for them in handling lumber, shifting saws, etc. The board should rim over and not under the saw—then there is no danger of loose pieces visiting the operator too suddenly.

There is no need of a top roll to feed in—in fact it would doubtless be a detriment as it would obscure the view of the saw should a board get started to be cut the wrong width, and it is just as well to let the hand feed the boards through to the rolls beyond the saw, a distance of only 16 to 18 inches at the farthest. The guide need not be more than two feet in length and not to go beyond the edge of the saw. It should be moved by a lever at the hand of the operator in one move and by ¼-inch notches. The movable saw should be provided with the same kind of a shifting lever, both of which should be plainly indexed. The idle roll frames at either end of the machine proper can be made of wood or iron as preferred. At the feeding-in end it should be fourteen feet from the saw. This length would make it equally convenient for boards from 12 to 16 feet long. The feeding-out frame should be of sufficient length to hold the boards from having any tendency to drop or sag and lift on the top rolls.

I forgot to mention that there should be a rod in front of the saws across the machine to guard against accident. There are, of course, different ways of accomplishing these purposes, but that I leave to the manufacturers, submitting that a machine properly constructed, having all these features combined in a thoroughly, practical and workmanlike manner, will make a gang ripping machine that will better fulfill its requirements than any now in use, being quicker, easier, and more convenient and successful in its operation.

CHAPTER XVIII.

SOME PERTINENT QUESTIONS CONCERNING SURFACE PLANERS—THE ILL TREATMENT THEY RECEIVE—A FEW ESSENTIAL FEATURES OF A GOOD PLANER—COMPARISON WITH ENDLESS BED MACHINES.

WHY is it that there is so much fault found with surface planers, large and small, roll and chain feed, all designed and built by men of more or less mechanical ability and experience, who study to produce a machine that will do good work, of the kind for which it is built, for ten hours a day, right along without extraordinary care? I have seen small pony surfacers feeding about twenty feet per minute, doing nice work on all kinds of hard and soft wood, without any apparent exertion or strain, and the next day have seen one just exactly the same in design and build—in fact an exact duplicate in every respect—feeding less and cutting lighter, groaning and gasping at every turn, aided by the curses and "belly" feed of the operator, producing work that might be mistaken for wash-boards, or stuff for a "corduroy" road. Who is to blame for this difference? Why is it that some machines will feed stronger with only two rolls, than others of twice the power, if properly handled? (No prize given for a correct answer to this question.)

How does anyone expect to do good work with a cylinder having two, three, or four knives, and only one to sharpen after running for a given length of time? Did you ever know of a case like this, and hear the operator make slurring remarks about the machine? I have, and thought that if the planer could only talk back, like the beast quoted in Holy Writ, what a heap of wisdom that operator might listen to, and perhaps profit thereby. I have seen a planer running, and—well, I don't know how to describe the work the operator produced, but you can imagine when I say

that all he cut was on the heel or back end of the bevel on the knife, and when I got that cylinder in the shop, the bearings were three-cornered, (that was the number of the knives,) just exactly like the form of the cylinder, and required to be reduced fully 1/8 of an inch to bring them to truth and perfect roundness.

I have known people to buy a small pony surfacer for a mere song, put it in a mill alongside of powerful flooring and re-sawing machines, built for the heaviest and fastest kind of work, and condemn the builder because the poor little machine, that cost perhaps only one-eighth as much as the flooring machine, did not keep up with those alongside it. They would take a three or four-inch plank and start it in without any support at the opposite end, which had ten or twelve tons leverage, and because it would not push it right along, consign it to Hades, (revised edition.)

I was once sent for to repair and start a new surfacer, 8-roll machine, which had left the shop in good order, after a thorough, actual test, and everything left all right for operation. All the purchaser had to to do was to align and level up, put on the countershaft and belts, and go ahead. In transportation a casting was broken, leaving nothing to support the attachment for the rolls. They sent for a new casting, and received it by return express. In the meantime they kept on using the machine, and got along all right until thicker lumber was to be dressed. They tried to raise the rolls with one end disconnected, and of course stripped the nut. Two hours work at the planing mill straightened matters. Result to me—journey two hundred miles each way, two days' time, and no recompense, not even "thank you." Do you think this will be a successfully operated mill if this is a sample?

Another time I sold a wide surfacer with two false bed-plates for special work, one straight and the other bevel, three-sixteenth, to produce a finished surface the second time through, that would be three-eighths on one edge and three-sixteenths at the other. This bevel plate was fastened under the machine in shipping, and in plain sight, but when it came to be used, instead of putting it on in place of the straight plate, the raising screws were disconnected, and one side of the bed frame raised three-sixteenths. The result was that the machine was all strained and spread, cylinder-boxes thrown out of line and ruined. I sent a man to straighten matters; result same as in the other case.

Why should this be so, and why should machine builders put up with such cases, and pocket the loss? Of course builders are liable to mistakes and should be made to right them, and also pay

for any damage resulting from such mistakes. Now if this argument is good for one side, why is it not good for the other. There are many kinds of machines built in the country, some good, and as many that are poor, and each maker will claim to build the best, but any man of reasonable experience and judgment can see the good and bad points when the machine is dissected and explained. My ideas of a good successful surface planer for general planing-mill work are, that it should have abundant feed and cutting power; pressure bars very close to the cutters and yielding to a limited extent; roll pressure by weights and arranged to yield at least one inch for heavy work; top and bottom cylinder adjustable to cut, and easy to get at, and to have all parts adjustable and quick to change and operate. These points put in practical working form will give good results.

I have seen such a machine cut a hard white oak stick, 12x6½ inches, feeding forty-five feet per minute, reducing it one and one-half inches or to five inches thick at one cut, and the same machine surfaced basswood ⅛ thick finish without being fed on top of another board. This is a solid fact that I can prove.

Chain feed, or "endless bed" machines are strong feeding machines, but as a rule, they do not have cutting power enough and I never saw one yet that had run six months that could do as nice work as a roll machine, from the fact of the joints wearing out of truth. They do first-rate for heavy work that does not require to be real nice, and for reducing freight on lumber shipments. Strange as it may seem they do not feed very strong on narrow stuff, as the boards do not present surface enough for the "lags" to get a good "grip," in other words, do not produce friction enough. Small surfacers that are used by cabinet and piano factories, etc., for hard wood and fine work should have all the four rolls driven; cylinders belted at both ends and the leading feature of the large machine. The cylinder should be steel-capped and the knives set close; run at a high speed, and for a six-inch diameter cylinder the pressure bars should be as close as ⅜ inch to the knives on both sides. I have seen such a machine fairly polish maple, walnut, cherry, etc., at a good rate of speed, and also plane three pieces of hard maple glued together on the end of the grain as nice as with the grain. Surfacing machines, large and small, with these ideas well combined, in the hands of a fair operator, are found to be successful.

CHAPTER XIX.

TIMBER PLANING OR DRESSING MACHINE.

THERE is perhaps no machine designed for saving labor in dressing wood, that is so rarely used and that will yield such good returns for its investment and cost of operation, as a good timber planing or dressing machine. Various reasons may be assigned for this, a few of which are its first cost and supposed limited demand; expense of operating; and lack of knowledge regarding its utility and advantages. Regarding the first reason given—its first cost—we find upon comparing notes and prices of machines which perform other functions on wood, that the timber planer now placed upon the market is the cheapest machine. This conclusion is based merely on the amount of stock and labor expended on it. It can be had at about the same price as a first-class planer and matcher, and to be properly adapted to its work, must be a great deal heavier and of the best workmanship and materials.

I said *supposed* limited demand because there are so few scattered about the country. Timbers have to enter into the construction of bridges, railroads, vessels, etc., either as they come from the saw mill, or be jacked by hand. Contractors and builders, knowing that they cannot find timber dressing machines in their immediate vicinity, have to take timbers as they get them, and as a consequence many timbers go undressed that should be square and smooth, because of the great expense of preparing them properly by hand. The expense of operating this machine is in fact less in proportion to its earnings than any fast flooring machine. The work being heavy calls for an extra amount of help in getting the stuff to and from it. As an illustration, a friend of mine who has a flooring machine that will dress six inches thick, told me that on his machine one day he dressed a lot of oak timber that measured 6x6, 6x8, and 6x9, and after figuring the cost of power and employes attending to the machine, he had realized

$60 net—pretty good for one day. He also said that if he had a machine that would dress four sides up to 16x18 inches he could make fully $100 per day for at least two or three months each year, as he could then work anything from 4-inch plank to a 16x18 timber. Outside of the regular car-shops of the country timber planers are but little used, partly because people think that the classes of work and building that would call for them are so few. This is a great mistake. Any one who has even a limited amount of work for one of these machines will be greatly surprised, after running it for a few months, to find what an almost endless variety and kind of work it will produce and how much its work will be sought after.

Every timber in a bridge, in steam, river, or canal boats, and all framing in the different kinds of mill work, for churches, schools, and other public buildings, could be framed and put together infinitely better and cheaper, if properly dressed to dimensions. There would also be a considerable saving on all work adapted to them. No one will deny that a frame of any kind looks neater and more workmanlike by being dressed; and it will also receive paint better, and take less to cover it. I might add that no one will deny that it is a very laborious job to jack off timbers by hand, especially hard wood timbers, or that a machine not only does it easier and faster, but better every way. I assert that there are not enough timber planing machines in general use.

Now this being conceded, we must find out what is required of such a machine, and how best to design and construct it that it will best answer its purpose. One feature and the most vital one about the whole machine, should be its strength, it should be so designed and built that it will do its work with comparative ease and all absence of strain; its framing should be very heavy and solid to withstand all jarring and racking to which it may be subject, and also to ensure a good foundation for all the other parts. For a matter of convenience as well as to have the greatest strength with the minimum amount of metal, I should prefer to have the framing made on the "cored section" plan—that is, each section or side having two plates or webs, and hollow or "cored" in the center. This is conceded to be the strongest possible shape in which to place a given quantity of metal. The rolls should be from eight to ten inches in diameter, and not less than eight in number, all strongly geared and at least two of them fluted or corrugated. I think this is one of the few places where a corrugated roll would do some good.

The under rolls should all be in an exact line and level, and so adjusted for height that they will not allow the timber to drag hard on the bed plates or platens. The upper rolls that feed into the cutters should be so arranged that they will yield or raise automatically at least 1½ inches to receive timber that is sawn taper or over size; all rolls should be fitted with shafts or bearings of large diameter in boxes of ample length which should be adjusted to provide for wear. The guides or fences on the right hand side should be wrought iron, having the ends next the side cutters faced with hard steel to withstand wear; they should be adjustable across the machine by means of screws feeding ¼ inch each turn, for convenience in measuring and also to equalize the wear of knives, bed platen, pressure bars, etc., and should be well supported at their rear side by clamping blocks to ensure rigidity.

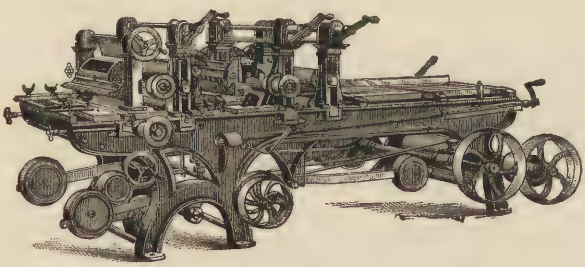
Particular care should be taken in the construction and location of the different cutter heads. Right here I wish to say that under no consideration would I be induced to purchase a machine for such heavy work unless I could finish all four sides at one operation, as the additional expense in re-handling the timber would be so much that the machine would be a poor investment. All cutter heads should be made of soft steel, slotted on all sides and fitted with good, cast-tool steel shafts running in bearings lined with the best of genuine Babbitt metal; they should be so designed that the cutters will project from the heads ⅜ to ½ inch and fitted with Norway iron cylinder bolts at least ⅞ inch in diameter. I would have the knives ½ inch thick as they would allow of the projection needed and be very stiff.

In feeding timber through a machine of this kind, the principal object is to finish it square and smooth, and for this reason the under cutter should be the first to come in contact with the stuff, in which case the timber would lie flat and true on the platen, and in turn be planed on its upper surface exactly parallel with the lower surface,and would also present itself perfectly square with the side cutter heads. Cutter heads so arranged would have the advantage of making the feeding much easier, from the fact that all undue strain incidental to rough, unevenly sawn timbers would be materially reduced, and they would also allow the last timber to be fed from the machine by the last pair of rolls, a function more important in feeding timber than lumber.

To be convenient as well as useful, an under cutter head in a machine of this kind should be easily accessible, and could be arranged either to draw out at the side or raise to the top, for the

purpose of changing knives. It should also be adjustable to a moderate degree in order to allow the increase or decrease of cut. The side cutter heads being so long or high above the upper bearing should have an extra bearing above the cutter; these bearings should be strong, and at the same time adjustable or movable, and secured by a clamping device that is quick and positive; all the cutter heads should be grouped together with reference to their strength and the convenience of handling and operating the timber. The cylinder pulleys should have face enough for belts 4½ inches wide, and the side cutters should carry a belt at least 4 inches wide. All belts should be of ample length; the driving pulleys should be large, with tight and loose pulleys, not less than 16 inches diameter and 10 inches face.

A machine of this kind would weigh perhaps seven or eight tons, and if properly designed and constructed should feed at the rate of fifty lineal feet per minute, even on white oak. It would probably take fifteen horse power to drive it, and would feed from fifteen to twenty thousand lineal feet per day without very hard crowding. It could be used successfully as an ordinary surfacing or flooring machine.



CHAPTER XX.

A CHAT ON PLANING AND MATCHING MACHINES —THEIR REQUIREMENTS—WHY A GOOD ONE SOMETIMES FAILS TO TURN OUT GOOD WORK—WHY A POOR MACHINE DOES NOT PAY.

WHEN a person gets ready to purchase any piece of machinery he has never used, he generally goes to some friend using that kind of machinery and consults with him regarding the best to buy, etc. Now this is especially the case with planing-mill machinery, and I beg to suggest that it is wrong in many cases. Said friend may never have owned, or had any experience with, but one kind and make of planing and matching machines, we will say, and that was built perhaps twenty years ago. What is his opinion on the subject worth? Give it up.

Perhaps the intending purchaser goes to two or three friends of about the same knowledge, experience and judgment, and gets their opinions all around. Each one has the best machine or the poorest machine (which is very seldom), as the case may be. How much better is he off? Echo answers "how much." Perhaps he goes to several different manufacturers of said planing and matching machines. They tell him all they know, and sometimes more. Has he learned anything more than he knew before? Yes, a little, because one manufacturer can generally tell of some defect in some one else's machine, and by the time he gets around he begins to think that he has learned to look in just the right place for a good or poor point every time, but even this does not tell him which is best to get, because every builder can refer to scores of customers who purchased of him and have always had the best success, with no complaints, and the last machine heard from. It is an open secret that the best machines do not always produce the best results, nor the poorest machines the worst results. "What then," says the intending purchaser "shall I do?

It looks as though I have the chances against me when I purchase my flooring machine."

My advice to you is this: Get thoroughly posted on the requirements of a planing and matching machine, those requirements, which, if filled, will make a strong, durable, simple as well as a quickly changed and operated machine. Until you know what these points are, you may not get what you ought to have.

I will tell you what I think the most important points to be considered in a first-class matching or flooring machine. In the first place it should have a heavy frame, especially where any strain demands it, and for that matter the whole machine should be heavy and strong. It should have not less than six good-sized feed-rolls, strongly geared and driven, and these rolls should be arranged to be changed to different thicknesses very rapidly, and also have plenty of yield to accommodate great difference in thickness of lumber, as sometimes one board will get "lapped" over by the other and break the machine, if there is not a sufficient yield. They should have plenty of weights to flatten out any ordinary board. There should be three or four different rates of speed for feed, to suit all kinds of work that comes into the mill.

The top cylinder should be large, fitted with four surfacing knives, and arranged to use beading or fancy siding knives, located for any and all widths to the full width of the machine, without disturbing the surfacing knives. It should have a spindle of ample size made from the best tool steel, running in long bearings, and the pulleys close to the bearings. These bearings should have a heavy lining of the very best Babbitt metal and good oil or tallow cups, not self-oiling. The pressure bars on both sides of the cylinder should run to within one-half inch of the knives. The front one should yield any amount without changing its relation to the cutter head; the back one should have an adjustment for wear, etc., and enough yield for wet or "sticky" lumber.

It should have a false bed-plate that could be easily taken out and planed over, and finally it should be easy of access in all its parts and raise to dress six inches thick, by screws that travel one-eighth inch each turn.

The under cylinder should carry four knives and have two sides slotted to provide for the use of rabbeting, beading, and other knives. It should have an adjustment of at least one-half inch vertically; have close "throats," belted at both ends and be fully as easy to get at to adjust, change or sharpen knives, as the top cylinder. It should not be so that an operator would have to

climb under, over, or through a machine to get at it. The side cutters or matcher spindles should be made from best tool steel, fitted with a pulley having face enough to carry a belt sufficiently wide to do any duty required, up to jointing six-inch stuff. They should not be less than 1¾-inch diameter, fitted in long bearings and running on a good durable step that is self-oiling, as these places are not generally quite as easy to get at and oil often. Besides, the step, if properly proportioned and made, does not consume much oil.

Both the heads ought to move across the whole width of the machine by screws that travel ¼ inch by every turn. These screws should be steel in bronze nuts; the guides should be wrought iron and the "chip breaking" end steel-hardened. These guides should travel across the machine, but both independent of the heads, for convenience in adjustment for different amounts of cut on the edge of the board. The long or feeding-in guide should have a stop to come to its proper relation with the head. This stop should be adjustable to and from the head at least ¼-inch; the short guides the same. The guides should be set about ⅛-inch to the foot in length, "drawing" and in perfect line which each other, to keep the board "hugging" close to them.

Good matching can never be made unless the guides are properly in line, and a man will have no trouble keeping his boards up to the guide, if he gives them "rake" enough. The left hand matcher should have a good steel chip-breaker that would prevent the lumber from tearing, and yield at least one inch back, and keep its close relations with the knives. Matchers arranged this way will save a great deal on either a wide or narrow flooring machine, for by moving the guides and heads across the machine, you save, or what is the same thing, equalize the wear of the rolls, bed-plates, pressure bars, and knives. You can on an average use your knives three times as long, because when one spot gets dull you move over to a fresh or sharp place.

All the moving parts should have large wearing surfaces provided for taking up wear; all studs and shafts should be steel; all pulleys turned inside as well as out where the motion is fast, and accurately balanced; all boxes and wearing parts adjustable and easy to get at. Keep everything up as strong and close as possible. These are the leading, vital points in a good, successful flooring machine, and if combined and put together in a good, straight-forward, practical manner, without any fancy or gingerbread clap-traps added, will make a machine that will do good

work every time, and plenty of it. It will be a machine that will make the heart of the operator glad. Why? Because he does not have to shut down half the time to doctor it. He can change it very readily and easily; can get out a big day's work every day in the year (barring accidents), on any kind of work that comes within the capacity of the machine, and he can do it well every time, and at night when he goes home he is as satisfied with the machine as with himself.

I have seen a machine with substantially all these features, jointing stuff six inches thick and cutting off the left-hand head 1¼-inch cut, feeding forty-five feet per minute. I have also seen it feeding through seventy-eight feet of 2-inch yellow pine flooring per minute, and seventy-five feet of ash (1-inch) flooring per minute, running measure, and it does it every day. I have also known of machines like this, that the "operator" never could do any decent work on, and I think never will. He is a "one-machine" man, that is, he ran an old-fashioned machine that was good in its day, for over twenty years, and got far enough educated to manage to grub out enough work for a small country mill, and just got educated to the old machine by the time he had to change to the new one. Twenty years to learn to partially operate one simple machine! What is such a man worth in a planing mill in these times of fast speed, high speed, and so many varieties of work and careful selection of lumber?

Finally, no man can do a fair day's work on an old consumptive machine, because he has to waste too much valuable time giving it medicine, in the way of repairs and make-shifts, but if he has a flooring machine that is good in every sense of the word, (and there are some manufactured in these times,) I submit that it is his own fault if he does not do lots of good work without much exertion and delay. In fine, he should make both himself and the machine a perfect success.

CHAPTER XXI.

CAST-IRON AND STEEL CUTTER-HEADS—PROPER METHOD OF CONSTRUCTION AND LUBRICATION —"OPEN WING" HEADS.

WHY do cutter-heads get out of balance, and what is the best preventive? are two questions that trouble a great many mill men, and have been propounded to me frequently. When cylinders are turned out from any reputable shop, they are bored the entire length, and the shaft or spindle fitted therein.

Here is the first chance to spoil a cylinder's running qualities, for on account of the hole being so long, it may not be round or parrallel throughout the whole length, unless done by an expert machinist, and as the steel shaft must be a very tight fit an imperfection in the whole will communicate to the shaft in driving in. This can be turned straight, round, and true, and accurately balanced, but if it ever gets well-heated while running, it will spring back the same as when first fitted.

Again, a cylinder if made of cast-iron, should not be cast just about the finished length, because, when so done, the dirt, slag, and other impurities, all gather at the top and cause the iron to be porous, dirty, and uneven in weight, consequently a good running balance can scarcely be attained. Although this is wrong, it is also a cheap method, and is done every day. The proper way is to cast about one foot too long for the cylinder, and cut off the surplus length. This gets rid of the imperfect parts, and leaves only the sound iron, and with good workmanship a perfect job is an assured fact. Owing to the fast speed and heavy weight, only the best hammered tool steel should be used, which makes a difference over common machine steel of at least three times the wear in favor of the best.

Cylinder bolts should be forged and turned from the best Norway or Swede iron, to withstand the service required of them, in securing knives, and the abuse they get from brawny arms and long wrenches. A set of new knives should be carefully tested,

to see that they are correctly balanced and kept so. A knife out of balance a little, throws the cylinder out, makes rough work, and wears the bearing. This, when once started, grows no better very fast, and getting the knives back to balance does not remedy the matter. Both the spindle and boxes are brought to that state where a machinist's services are called in, and the cylinders re-turned and balanced.

Cylinder boxes should never be babbitted with the cylinder in, as it will, in ninety-nine cases out of a hundred, get sprung by the hot metal being suddenly poured on it. A plain iron arbor kept 1-100 of an inch larger than the cylinder bearings should be made and fitted for the cylinder every time the bearings are re-filled. It should also be nicely straightened every time it is used, as it also is sprung by the babbitt. I have seen a 5-inch iron shaft spring out of true 1/8 of an inch, in this way, also a 4-inch tool steel shaft. Of course these were straightened and turned down to fit afterwards.

Matcher spindles should be treated in the same general way. And right here, I suggest, that altogether too little care is used to keep matcher cutters in balance. They are so small and light that most people think that they can't be out much anyway. The fact of the matter is, they require as nice balance and adjustment as the surfacing heads and knives. I can go to a pile of finished lumber and tell how a machine has been kept, and also how many or few knives have done the work by examining the feed marks on the boards.

Cylinder boxes should not be self-oiling, for this reason; if the self-oiling device is depended upon, it does not self-oil some fine morning, and your bearings are ruined because the oil chambers were not replenished in time, or they became clogged or gummed. If they are not to be depended upon, what are the benefits derived from them? There are some places on machines where self-oilers can hardly be avoided, such as the upright or matcher spindle, as the oil poured in by hand would soon drop out. These can be made so that they will do good service, by arranging a large oil-chamber on the box caps, and feeding the oil by capillary attraction through a hole at the top of the box. This will allow the whole box to be properly lubricated, and should be looked after often enough to be sure that there is always plenty of oil in the chamber. For cylinder boxes, I prefer a large tube about three inches high for tallow. Pour in the oil and then put in tallow of good quality. In this way, if the oil should run

out, a very little heat will melt the tallow down and avoid serious damage.

While on this subject, I would like to say that after using all other kinds and brands, I prefer the best extra lard oil I can buy as the best and cheapest in the end. It does not gum like the heavy oils, nor run away so fast as the light oils, and you do not use one-half the quantity. The fact is, it is grease all the way through, and good measure. I don't want anything better for wood-working machinery, having had considerable experience with loss to myself.

Cylinders on surface planers should have at least one-sixteenth end play, to prevent abrasion if they should, from any cause, get heated enough to expand, and on flooring machines where beading and fancy siding knives are used, (and I would put them on by all means,) should have from one-eighth to three-sixteenths end play, and arms fitted with wooden plugs or screws to keep the cylinder from vibrating, and also to shift endways for the allowance of fine adjustment of beading and other knives, should they not come exactly in place at the first setting. This saves stopping the machine and re-setting knives, and will be found generally convenient. The reason I prefer to have the beading and fancy knives placed on the main top cylinder is, that it dispenses with an extra cutter-head and its care. All the knives can be set at one time and place, and the beading or coves will always "track," which is not the case with an extra head. Besides, it will always keep its place and stay put, and if a board by any chance should leave the guides after the tongue and groove are cut, the bead or cove is also cut in its proper place and no harm done, while the reverse is the case with an extra cutter-head at the delivery end of the machine. The full knowledge and application hereof will greatly tend to the success of both operator and mill.

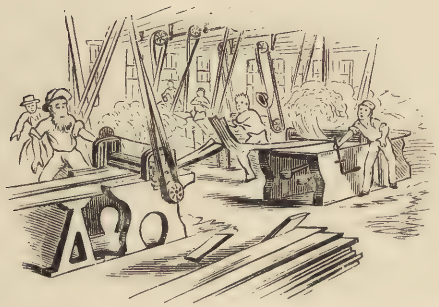
Thus far I have referred only to cast-iron heads, because they are the most commonly used, and for general work are as good as any thing else. Some use wrought-iron, some steel, and a very few brass. The objection to wrought-iron is that, when a good shavings-throat is planed out and the lip or knife-cap brought to a proper shape to roll a chip easily, it has no strength. It is liable to chip off the whole length, and has no advantages worth mentioning. Brass is too costly, soft and easily bent by any sudden blow, unless made with a very thick lip or cap. Steel is all right, but is costly if fitted up properly. The heads are generally forged with heads and bearings all in one piece, the bearings roughed

off, taken to the planer, reduced to the proper size and shape, and thence brought back to the lathe to be finished; no boring of cylinder or fitting of shaft therein, making a cheap job, but also a poor one, because, while the soft steel is just the thing for a cutter-head, it is not just the thing for the bearings; being of a very soft quality of steel the bearings soon become worn, are re-turned again and again until too small for use, and, finally the head goes to the shop and has to be bored out for a new shaft, and, perhaps planed over. The proper process by which to get a soft steel forging for your cutter-head is to bore it out and fit it in a good cast (tool) steel shaft, which when fitted up properly, makes a first-class job, and also has the additional merit of costing at least twice as much as cast-iron. They are, however, seldom called for and only for certain kinds of work where the cylinder has to be pretty well cut open with slots and bolt holes. I want any cylinder to have plenty of "throat" to roll the shavings from the knife easily, because I can do better work, feed faster with less power and keep the knives sharp longer in consequence of getting clear of shavings more easily. I also prefer a cylinder for a fast feeding machine to be large and have four knives instead of a small cylinder with three knives.

A large cylinder does not work so much "end wood" at any part of the cut, but has a long, easy, and what might be termed "natural" cut, and takes less power, does a great deal heavier cutting, and if fitted with four knives leaves each knife less to cut at the same rate of feed, or will cut the same per knife, feeding one-third faster. I have seen a large four-knife cylinder taking off one and one-half inches, twelve inches wide, white (dry) oak feeding forty-five feet per minute, and don't think any small cylinder can equal it. Did you ever run a brass "open wing" head, old style, and if so, how did you like to go through the operation of balancing it? Oh, what fun you have when one wing gets sprung from a hard knot or loose knife. You try to load it to a balance with washers, etc., until you get disgusted with it. Then a machinist having turned the bearings true, gives you a good balance and you start. Another snag after a few hours' run, and you have the operation repeated.

I have seen this thing done even when the wings had stay-bolts to prevent springing. They finally went to the brass foundry for old metal, and were replaced by a good iron head. I don't know what idea the person had who invented the open-wing head, but I do know that he will never be canonized or knighted

by the consent of any one who ever used the old style brass head. They were profitable jobs for the brass founders, however, and it is another illustration of the saying, "It is an ill wind that blows nobody good."



CHAPTER XXII.

THE USE, ABUSE, AND CARE OF CYLINDER CUTTERS AND BOLTS.

I HAVE for a long time observed the uses and abuses of knives and cutters for wood-working machinery, as well as the screws and bolts that secure them to the cylinders or cutter-heads, and have become convinced that at least ninety per cent. of delays, breakages, and accidents, are due to ignorance and carelessness, not so gross perhaps on account of their imperfections being partially or wholly concealed from any one who is not looking particularly for them.

It occurs very frequently that a cylinder knife is torn wholly or partially from the head, a number of the cylinder bolts being carried with it, or at least so badly damaged as to be unfit for further use, while the tapped holes to receive said bolts are still in a perfect state to be used for a new set. When after an accident of this kind, the machine is brought to my attention for repairs, I very often find that the man who had charge of it, criminates himself unwittingly, thus; "Why, I had just put on a set of sharp knives, and the machine had hardly got under regular speed when she struck the first board, the knives tore off, etc." In a case of this kind I need no more information to prove almost conclusively, that the bolts were not brought properly home before starting, and consequently could not stand the strain given the knife when it commenced to cut, the knife raised a little and "struck" some obstacle or allowed shavings to wedge under which finished the job.

I know of one (among many others) like this, where a large cylinder tore out, and actually went through the upper floor, broke both pressure bars, cylinder boxes, frames, bed plate, matcher-heads, gears, &c., entailing a bill of $350 for repairs, and yet the operator had not got the first board into the feed rolls.

Again, the risks are greatly increased by knives not being properly balanced. When I say "balanced" I mean absolutely

balanced. An ounce too light or too heavy, traveling on a circle of sixteen to thirty inches, at a speed of 3,500 or 4,000 revolutions will shake a machine whose weight may be from two to six tons, so you can readily infer how much force this little item amounts to.

Another matter that needs careful attention in this connection is that the face of the knives that lie next to the cylinder head should be flat, or having a slight concave its whole length from the cutting to the rear edge. The value of this is that the knife will then have a firm seat on nearly its whole face when bolted on. Some builders in order to make sure of this, plane the knife seat of cylinder straight to within ¾ of an inch of the back edge, and then raise the tool to cut about 1-32 higher. This leaves the knife lying firmly on the front edge, and also on this ridge behind the cylinder bolt, while in the center of the knife it does not touch the seat. When the bolts or screws are brought home, the center of the knife is caused to spring, and lay solid as the rest, so that if a knife is *not* straight, but a little concave, it does not matter.

Another prolific cause of shrinking knives and bolts, lies in the fact that many operators will use only two cutters on a four knife cylinder—it is so handy you know, saves grinding so many knives, and so forth. Now, aside from the difference in the quality and quantity of work produced, the two wing edges that are running without knives, come in contact with knots, splinters, and other objects that wear and break off the edge and leave a rough, blunt, broken surface, and when the knives are replaced, it offers the most desirable inducement that could be invented for slivers, chips, and shavings to drive under the knives. Once started it is good-bye to knife and bolts, even if nothing worse occurs. A cylinder that by any accident has the edges broken this way should be taken to the machine shop and be planed true, or at least have the broken spaces filed so that they will be at a sharp angle, and brought to almost a knife edge. Slivers and chips will not tarry long where such is the case, but will commence to roll out of the throat as fast as cut from the board. Knives should be at least 1-50 of an inch thicker at back than at the front edge. This will prevent any tendency to "throw" out from under the bolts. I recently came across a lot of knives that were "flaky" around the bolt slots—that is, there were spots upon which the washers or bolts could not find a true seat to rest. I returned them to the maker and he replied that I was too high-toned about the finish. I am not particularly æsthetic about the finish, which, however, should be done as well as the rest, but I do want a true surface

for the bolt heads to screw down upon, and submit that this is a very important part of the knife, also one that is not generally understood.

Another very frequent cause of knives flying is, that they are screwed down too tight. This may seem paradoxical, but I will explain. A planer leaves the builder's shop presumably in good condition, after proper construction, etc., and is placed at work. Very few operators take out the cylinder bolts and oil them, say once in two weeks, or even give them a casual examination as to their condition. These bolts need a little lubrication once in a while. They get dry and hard to turn, and as very few operators stop to figure out the strength of a screw or bolt, a big wrench is put on the bolt-head, backed by a bigger man, and the "yanking" goes on until the screw or man gives out from lack of strength or wind. A man with a 12-inch wrench in his hand exerting a strain of 100 pounds, just pulls 1200 pounds on that bolt-head, or with a 10-inch wrench pulls 1000 pounds. If the screw is twelve threads to the inch this strain exerts a holding down pressure on the knife of about forty-five tons in the first case and over thirty-five tons in the second case. Multiply this by six, the number of bolts on a 24-inch knife, and you will find that the great centrifugal force is overcome many fold by the holding down pressure of the bolts. This, of course, is as it should be.

If ninety-five out of one hundred operators of planers will take the cylinder bolt out of the planer that has been constantly run for three months or over, they will find that the portion of the thread that does not enter the hole is stretched considerably, or in other words the lead or pitch of the thread is coarser. I have seen them so bad that a screw that was twelve threads to the inch stretched under the continual strain to nine threads. This of course weakens the bolt to an infinite degree, and is caused by too much strain on the wrench, hence I said, they were screwed down too tight. It is a very easy matter to tell when a screw is home, and then the wrench should stop there. There is a certain feeling in a wrench that tells an experienced hand when to stop.

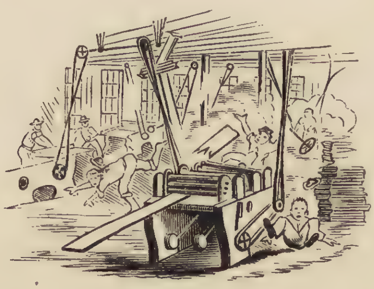
I would under no circumstances allow any cylinder or knife bolt wrench to be more than twelve inches long. I would also hide the "gas-pipe extension" for wrenches. A certain party complained that his bolts would not stand as they were improperly fitted, of poor material, etc. Upon going to the mill to investigate and prove the contrary, the machinist could not get the bolts in question out, neither could the planing mill foreman.

The latter said that he would get the man that screwed them in. He went to the yard and soon a big burly son of Africa appeared on the scene with a piece of gas-pipe 2½ feet long, stuck it on the end of the wrench and the result was that the bolt came out in a hurry. The planing-mill man did not conclude his argument of complaint. This is an actual fact.

Another case was that of a customer who brought us three cylinder bolts all stretched and stripped of their threads, and he complained of them. We took two of them and bent them double while cold, and showed him that only the best of Norway iron would have stood the abuse they had. Steel is the strongest, does not yield or stretch, but snaps off without any warning, so that for all these reasons a good bolt forged from the best Norway bar iron has proved the most successful.

Another reason why knives throw out, especially on cylinder heads of small diameter, is that the holes are so shallow in many cases, and the screws or bolts are fitted to almost touch the bottom of the hole, and as a matter of course, when the bolts get stretched until they bottom in the hole, while they screw home, do not bind the knife properly. Of course no reputable builder intends to have this occur on his machine, but how is he to tell how much those bolts are to be stretched before they are replaced? I have seen bolts that were originally 1¾-inch long come to the machine shop, having grown to a length of two inches. The best plan is to examine occasionally, and carefully clean and oil the screws and hole, replacing with new bolts when found necessary.

In conclusion, I beg to remind you that eternal vigilence is the price of success, and to attain that success we must not despise the day of small things.



CHAPTER XXIII.

CUTTER ANGLES; AUTOMATIC, OBTUSE, ACUTE, AND OTHERWISE CONSIDERED.

FOR a number of years I have been on the lookout for a plan whereby to reconcile the various theories regarding the proper angles that cutters should have in order to produce smooth surfaces. I have not yet found it. It would not be worth a cent if I did, because it would convince but few of the operatives, even after a fair demonstration of the facts. I have also been longing for a self-adjustable cuttter head that will automatically change the cutting angles the instant a hard wood pile is placed behind the machine after feeding soft wood, and *vice versa*. No other plan will answer. To be complete it should also be able to adjust the angles so that they would be more obtuse when passing over knots or cross-grained pieces, and then re-adjust them for straight grained stock. It must do its work just as the new-fangled automatic steam engines do. I have no great hope of finding this kind of cutter head for some time. There is a bare possibility of being struck by lightning sometime, but—.

Some people may think that I am unreasonable, but my defense is that I am only voicing the *real* demands of hundreds all over this big country. Perhaps they have no idea that they make their demand so strong, but I assure you I am not exaggerating. I never do. Their requests may not be worded in the same manner in which I put them, but they amount to the same thing. I have taken out an extra life insurance policy, and propose to talk right out in meeting. There are more than a few people who know very little about cutting angles as applied to rotary cutters for dressing wood. I won't feel indignant if I am classed with them.

There are two extremes to be found in dressing or forming the surface of wood, viz: severing the fibres or cross-cutting the grain. It is well known that the former is accomplished with a great deal less power than the latter, because it will allow of a very fine, sharp, or acute-angled wedge being used, while to sever the cross

grain requires so much more power that an acute-angled wedge will not answer, consequently a wedge having a more obtuse angle is called into requisition with successful results. All cutters are wedges, and all cutting on wood is done by wedges. Again, an obtuse-angled wedge or cutter will cut hard wood better and last longer than an acute-angled cutter, because the hard wood grain is so close and fine that an acute-angled edge would last comparatively no time. The cutter presenting an acute angle or cutting edge is the sharpest, but does not remain so for any length of time, because the point or edge has nothing to support it, therefore it crumbles or wears away very fast. All obtuse-angled cutters or edges are strong in proportion to their angle, but will not cut as fast or easily as acute cutters on soft woods. Having a stronger edge or point, they last or wear well on hard wood. The general average of cutting angles on wood-cutting machines, has been all the way from 35 to 65 degrees, and in a very few instances even more, but only for special cases, and peculiar work not often called for. The angle of 40 degrees has been found best for pine and other soft woods, and where it is mixed with some ash or spruce, 50 degrees, while for oak, maple, etc., 60 degrees would be most suitable, and 75 degrees for lignum vitæ, banyan, iron, and other woods of a kindred nature.

Now as no one machine has heads or wings that will adjust to these various angles, either automatically or otherwise, we have no alternative but to adopt an average, after leaving out the hardest kinds of wood, which are comparatively but little used in the general market, and a cutting angle of 45 or 50 degrees will be found to give better satisfaction than any other, especially as some of the leading machines of the country are built to-day, having their pressure bars as close to the radius of the cutters as safety will allow. They hold the lumber firmly, and avoid slivering or tearing rough, wainy, or cross-grained lumber.

I would have and keep on hand a set of knives for dressing hard wood, ground on the under side, extending back 1-16 to 1/8 of an inch. These will change the angle to any degree you choose, by simply grinding to a different bevel. If you draw a line on a knife or cutter that cuts at an angle of 45 degrees, you will be surprised to see how little grinding on the under side will change to 65 degrees. I have seen knives used this way on a large machine that were fitted to cut at 40 degrees, and the result on the hardest kind of wood was as good as could be desired, in fact it could not have been done better if a new head had been

built for the purpose. This method has the advantage of being cheap, reliable, and always ready.

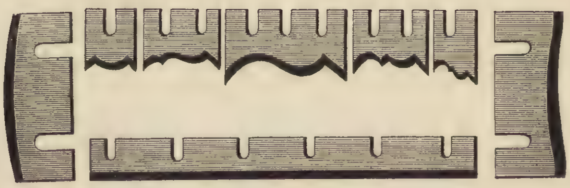
A great deal has been said concerning the value of, what are termed, "chip breakers," under the knives or cutters, but their real value is of but little account, except in very few cases. The principle of the whole thing is false. I am aware that I am treading on the toes of an old-established custom that is dear to the hearts of many old builders and users, but nevertheless, the fact still remains. In the first place they may break off the chips or shavings, but they do it at the expense of power. They check the power of any machine in which they are incorporated, in proportion to their close proximity to the cutting edge. I prefer to have cutters stand at least ¼ of an inch from the edge of the head, and if possible, have the head cut under to what is known as a throat, for the purpose of allowing the shavings to roll away from the cutting edge. The great object of keeping the cutting edge free or clear from cuttings, is thereby accomplished. Knives standing well out would have to be strong and stiff, but with an under-ground bevel and good pressure bar that would yield freely and sustain close relations to the knife, will produce as good, true and smooth work as the closest capped or chip-breaking knife. This is also contrary to general theory and belief, but it is asserted only after careful study, experiment, and long and varied experience. The best proof of the fallacy of chip-breakers or caps placed under the knives, is that extra fine results are not claimed or produced until the cutter or knife is set back where it can scarcely be felt to project beyond the cap or chip-breaker.

Now here is the whole secret; when the knife is thus set back, the cap is not a chip breaker at all, but forms a curve or throat to assist the shavings to roll away to a limited extent, besides being really an under-ground bevel (or what is the same thing, a different angle,) for the cutter, hence it is clear that if the cutters do their best or smoothest work when thus set back, they do it simply because the cutting angle is thereby changed or made more obtuse, and the work varies in quality as the cutters are set forward or back.

One reason that some machines will not do as good work as others is, that even with all these angles and pressure bars con sidered and taken advantage of, the feed is not changed to a proper limit. Hard wood cannot be rushed along, no matter how powerful the machine, because the limit of strength or durability is in the cutting edge of the knife, and in this connection it would

be well to grind a double bevel on the back of the knife, that is, grind a knife to as long bevel as possible without touching the edge, then re-grind a bevel from the edge back about 1/8 or 3-16 of an inch. This will give a sharp cutting edge, a strong support to the edge, and a knife that can be easily and quickly retouched with the file, stone or wheel, as the case may be.

I would add that the same general rules apply to the cutting angles of saw teeth for rip and cross cutting saws for either hard or soft wood. After due consideration I think I don't want the automatic, adjustable-angled duplex head as much as I did. I might have too much complication for my poor head if it had to be repaired. Besides, I think that a good pressure bar on the rough lumber, with the extra set of cutters having the little bevel on the under side, will answer every purpose and be fully as successful.



CHAPTER XXIV.

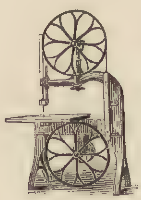
PLANER FEED ROLLS.

UNDOUBTEDLY too little attention is paid to the proper construction of the feed rolls, as well as their care. The common custom has been to take the roll shafts and true up or turn off the scale for each end of the rolls, cut one or more key-seats therein, and take it to the foundry and have it cast on solid and fast. This is a cheap, easy, and speedy process, but makes a poor job, as I can prove to you on examination of almost any such planer that has been operated any length of time. They will be loose in most cases. The trouble is that there is not enough cast iron poured on the wrought iron to bring the wrought iron shaft to a uniting or welding heat before the cast iron becomes too cool, and the result is that the fit is not welded but chilled, and very rough, and covered with "pin points" in its exposure to the cold. It is the "pin points" that cause the trouble, because from the constant pressure and torsion they become worn off, and the fit on the shaft (it never did amount to anything) is spoiled. The proper way is to fit the shaft in, after boring the rolls true and pressing to a tight fit, or better yet, on large rolls, to cast the shafts in at the foundry as above mentioned, then recess the roll at each end about one and one-half inches deep, and press in a collar that is a tight fit on the shaft and in the collar, and you have a job that will not bother you during your natural lifetime. A planer can be made to do good work if the top rolls are loose or out of true, but the lower rolls must be kept perfect to insure accurate work, because the board when fed on a loose roll is up, then down, and also has a jerky motion or feed, which is only too plainly shown in the work.

Now about setting rolls in a planer. This is a very important matter, as the questions of feeding easily, and also of "chopping" the ends, have to be considered. It is generally known that rolls

can be aligned wrong, but it is not so well known how to set them correctly.

Now, I will tell you how it can be done to feed with a minimum amount of power, save the ends of boards, and prevent the boards from "chattering" or vibrating when under the cutter knives. In the first place, see that the bed-plate or platen is true and take an ordinary business card, tear it in two, place one piece on each edge of the platen, set the straight edge on them, and raise the end of each roll on either side until it just touches; go to the other end of the platen and repeat the process, and after proving the operation you are all right as far as a four-roll machine is concerned. But for a six or eight-roll machine, place the end of a straight edge at the middle of the platen (as it feeds,) rest it on the roll next to it and raise the outside or first feeding roll to the edge, repeat the operation for the last delivering roll, and your machine is set for thin stuff, flooring, etc., up to an inch and one-half thick, because the board feeds down until it strikes the center directly under the cutters, and up from there out. This causes the board to lie firm on the platen while being cut. The first feeding and last delivering rolls should be set in a perfect alignment for thick stuff, as that will not yield or spring much, and for very heavy stuff from four to six inches thick and over, it scarcely touches the platen and does not vibrate or tremble on account of its thickness and weight.



CHAPTER XXV.

A GUIDE FOR GUIDES—MATERIAL FROM WHICH THEY SHOULD BE CONSTRUCTED—THEIR ADJUSTMENT—A "MISGUIDED" OPERATOR—WHO OFTEN PAYS FOR THE CARELESSNESS OF OPERATORS.

IN a previous article, I gave in a general way, the manner in which the guides should be constructed and adjusted, in order to produce straight edges, but before proceeding farther, I would like to call attention to the fact that a great deal depends on having true guides made from the proper material, as well as keeping them true.

In the first place no guides should be made from cast-iron, nor should you tolerate any that are, because no matter how heavy or strong they are, the size and strength must be reduced as they pass under the cylinder and pressure bar, and as no casting is stronger than its weakest points, all the outside matter is useless. Again, should a cutter get loose and strike the guide, if it be a casting it will be broken, whereas if it be wrought it will simply become sprung or bent, and can easily be made true. To illustrate this idea, I note two incidents that came under my notice.

I saw the foreman in a mill putting on a wooden guide. He took me into the tool-room and showed me a heavy cast-iron guide, broken very badly, and the wooden guide was a make-shift until the iron one could be repaired. I remarked to him, "You should get a new wrought-iron guide made with a steel end or chip-breaker hardened." "Oh" he said "that would cost too much." I soon convinced him that it would cost more than one half the price of a good, new guide, to repair the old one, and then at best he would have only an apology for a guide.

A few days after, a friend came to me with a wrought-iron guide of which he complained, saying that he could not cut anything on the last foot in length of the board on the guide side, but cut almost half-an-inch too much on the opposite side. I

tested with a long straight-edge, and found the guide bent for the last foot about one-half of an inch out of line. The board kept springing the guide until it left the feeding-in rolls, and then the guide sprung or pushed the board away from the matcher-head. The blacksmith straightened it in about ten minutes, and my friend went on his way rejoicing.

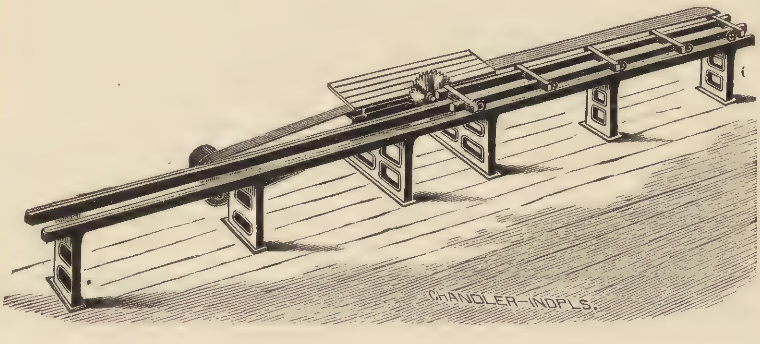
Guides should be well "backed" or supported in order to keep them from springing, because if they get too great a draw, or the rolls work the board in that direction, they should be rigid enough to resist any strain, especially for the last three or four feet before reaching the matcher cutter. Short or feeding out guides should be arranged in the same manner, and should be independent of the long or feeding-in guide for greater facility and ease of adjustment. The short guide will produce a hollow edge on the end of a board, if the last or delivering end presses the harder against it, and it will show a ridge, if the receiving end presses the harder. It should be set exactly parallel with the long guide, and at an advance to correspond with the amount jointed off by the cutters. Guides can be set so that no levers are needed to hold the lumber against them if the rolls are kept parallel. Give them about one-eighth pitch or rake to the foot in length, so that the lumber, as it feeds, will draw against it.

I once had a little bitter experience in this line with a machine that was thoroughly tested at the works, and properly adjusted, and after it had been started in the mill would not hold the lumber up to the guide, and when held up by a lever would leave ridges and hollows at the end of every board. Such matching you never saw. I was sent for at a distance of three hundred and fifty miles, to get the machine right, after it had been partially condemned. In about twenty minutes I had it matching as nice as any one could desire. The operator had "set" the guides, notwithstanding he had been instructed that the whole machine had been properly adjusted. He had set the pitch the wrong way and did not have one in line with the other. Other deficiencies he had shown, but I will not mention them now.

This reminded me that some one pockets another loss, to be charged to traveling expenses, to say nothing of time that was especially valuable on account of a great pressure of business at home. Remember, I do not claim that every board handled in a year will "hug" the guide, neither will they even when you use a lever to force them against said guide, for, once in a long time, a person will come across a very crooked-edged board which is also

of uneven thickness across the width; this will bother any one. But my point is this: Where a man has to examine each board and turn it over before feeding at the rate of seventy to eighty feet per minute, he does not have a great deal of time to hold a lever, and of necessity must have his guides aligned and adjusted right to produce good jointing or matching.

I hope these few notes and incidents will serve as a guide to some extent for those interested in this subject.



CHAPTER XXVI.

MOULDING MACHINES.

I HAVE been studying up the subject of moulding machines, and have listened to many arguments *pro* and *con*. I asked Rushing what a moulding machine was, and he replied that it was a machine designed by machine builders for the purpose of keeping a continual bill of account on their books against the purchaser, and also for using up old broken planer knives, scrap steel, etc., for cutters; at least, that had been his experience. I believe him, as far as regards his experience, and judged by the appearance of his cutter-heads, that he could utilize a large scrap heap to keep them balanced. He says that one knife is just as good as two or more. I noticed that his cutters revolved about 2,000 turns per minute, and the machine was feeding seven or eight feet, but the heads jumped as though they were making 7,000 per minute.

I went to Green and jotted down his opinion. You see Green doesn't do a great deal of work in the moulding line, only keeps one machine to fill in orders together with his manufactured lumber. He says that a moulder is a machine built for the purpose of making mouldings of all kinds, and principally to keep a man fitting up knives for all the new patterns of mouldings; says that he pays more for fitting up the machine for some odd kinds of mouldings, than he gets for the whole job. Green wants to know why orders of that kind are not accompanied by cutters of the requisite form.

Eastlake says that moulding machines are built for the purpose of economically producing mouldings of any desired profile, and that his machines do it, too. He says that there are lots of narrow light strips taken from stuff at the saws, that without the moulding machine could not be used for anything but fire wood, whereas by using the moulding machine they make the nicest mouldings for all kinds of furniture and other fine work. He

has over eight hundred pairs of profile cutters of all shapes necessary for his business, and all widths up to eight inches. Hundreds of dollars are represented by these cutters, some of which have not been used for many years. I suggested that a good deal of capital was thereby lying idle; he replied that he did not so consider it, because they had paid for themselves time and again.

I notice he does not use old planer knives and such when he wants a new style of moulding, nor does he have any wavey work from his machines. If he cannot produce the required shape by using some combination of his old knives with a little alteration, he gets a pair of blanks that are already slotted, lays them out to the proper shape, takes them to the emery wheel and roughs them down, grinds the clearance, and finishes the edges up nicely with a file and oil stone, then puts them on the machine which travels 4,000 per minute, and produces a moulding strip that only needs to be lightly sand-papered to be O. K.

No single knife on his cutter-heads; time and labor cost too much for that kind of business; no make-shifts of any kind. Just the best he can get is none too good for him. He says that no money can be got out of a moulding machine, but in the same way in which it is extracted from any other machine.

Rushing says that he doesn't have enough mouldings of a kind to warrant such a piece of extravagance. I remarked to him that if he took the little extra time to finish the second knife, he could speed and feed his machine just twice as fast, and have work that would be infinitely better every way, and he would not wear his machine out so fast. I don't know whether or not he has profited by my hints, but would not be disappointed if he had not, for he is a man who thinks he is sufficient unto himself.

Outside moulding machines, as a great many of them are now made, are "stickers," that is, about every piece that is fed through them sticks on its way before it is coaxed through. Perhaps this is why they are often called stickers; I never heard of any better reason. They stick themselves, stick the stuff that is fed through them, and stick the operator. Truly, they are worthy of their name.

Why moulding machines that are intended to cut or remove more stock than a large flooring machine, are built so light and frail, have such light cutting spindles, and meager feeding power in comparison, is one of those things which as Dundreary says "No fellah can find out." Of course there are good moulding machines built by a few manufactures, but on the other hand

there are many that, to say the least, are none too heavy. A great many have only two small upper rolls, and no lower one; some have one lower roll that is an idle one, while others have one that is driven.

Every moulding machine to cut mouldings of six inches or over in width, should have at least two upper and one lower roll all driven strongly, and in most cases two pairs driven, not for the purpose of having an extra high rate of feed, but to do the work easily and surely. The frame should be perfectly strong and rigid to withstand any inclination to vibrate or tremble; well jointed and tied together so that it will be as solid as though cast in one piece.

Spindles for cutters, both upright and horizontal, are as a rule too light for the purpose. They do not carry wide knives or heads, but they have very heavy cutting at times, and you can hardly have too strong a spindle with good long bearings. The upper and under heads should have an end adjustment for the purpose of bringing the knives to a nicety after being set and found to be not quite properly located; the under head should have an independent raising adjustment to allow of changing depth of cut, and should also be provided with a "throat-piece" in the table that will move towards and away from the center, for the same purpose; the outside cutter-head should be arranged to cut at an angle to at least twenty degrees, and the inside one would also be better for many purposes if so arranged. Pressure bars and plates should be so hinged or secured that they can be easily and quickly got out of the way for changing, etc. They might in many cases be longer and wider than they are as friction would not be increased except by additional pressure. The slides or bearings for the table to raise and lower on are generally long and deep enough, but seldom as wide as they should be, that is, not spread far enough apart. Probably it is for the same reason that a long shallow bureau drawer that is wide does not slide so easily as a long narrow pigeon-hole drawer. One thing is certain, the tables are likely to tip at either end as the pressure happens to be. "Outside bearings," as applied to machines of the latter-day class, help to support top heads to a great extent, but some of them are none too solid, in fact are bearings only in name.

Outside moulding machines are sold and used for at least nine-tenths of all the moulding work in the country, as the method of making "built up" mouldings, that is, producing a wide or deep

moulding from several pieces of stuff—allows the use of a much smaller and lighter machine than formerly.

Outside machines, so called from having their table and all but the right hand side head outside the frame, are well known to be the most convenient for all kinds of light work, but it is an open question whether they are not too light in many instances. I suppose that like a great many other machines they are built to suit the size of the purchaser's purse; this, I think, is a false principle for machine builders to act upon, because a difference of two or three hundred pounds of iron, a little more steel, etc., together with the extra work attending its construction, do not add so materially to the cost, but it can be sold to much better advantage and at a price that will compensate for the extra work. The manufacturer as well as the purchaser would be better pleased, and the latter would be earning more every day he used it.

Inside machines, or machines that have all their cutter-heads inside the frame are generally used for a heavy class of mouldings, either very deep or wide, and as a consequence, are built considerably heavier. They should have at least four feeding rolls, all driven, and all the adjustments I have mentioned as being requisite on an outside machine. They are not so much sought after in the general market as formerly, owing to the different demands of the trade, but are evidently up to a better standard as regards strength, proportions, power, etc. However, they are still used extensively in establishments that have a large variety of heavy work to do.

CHAPTER XXVII.

VARIETY MOULDING OR UPRIGHT SHAPING MACHINES.

OF all the machines used in mills or factories for the conversion of wood, there are none more simple in their details of construction and operation, or that can be made to perform so many different parts as the variety moulding, or as it is often called, upright shaping machine. In fact, its uses are so many that I am inclined to believe it might, with more propriety, be called a universal shaper or wood-worker.

It is to a wood-working establishment, what a universal milling machine is to a well-appointed machine shop. What will it not do in competent hands? There seems to be no limit to its capacity in producing almost any shape or form in either a straight line or regular or irregular curves. Any style of moulding, jointing, etc., can be quickly and easily produced by it, either straight, in circles, ellipses, or any irregular curves, in a manner not equalled by any other machine.

Take for example a few of the many pieces in a cabinet factory—bedstead sweep mouldings, post caps and feet, side rails, frames and panels, bureau and washstand tops, backs, boards, feet and partition mouldings, doors, brackets and panels, all kinds of table-tops and drawers, stand tops, straight and serpentine legs; center table work, and in fact, nearly everything needed in stand and table work; mantel shelves, frames, brackets, beaded work, counter tops, pier glass frames, sideboard and book-case work, window cornices, chair work, etc., besides an endless variety of art work generally; and so we might enumerate through the different branches of carriage, piano, organ, agricultural, architectural and wood-work generally.

Right here I might say that it used to be the original buzz-planer as far as the width of its cutters would allow, as precisely the same kind of tables or form, was always used on it for edge jointing, etc. It is also the most dangerous machine in the factory when carelessly handled. Scarcely any one operator in a hundred, but has left more or less of his fingers in its "greedy mouth," rather costly souvenirs. I have yet to find a person who

has run one of these machines for any considerable length of time, who has a "full hand" or "two of a kind." This state of things is due to several causes, but a few will suffice to illustrate, viz: dull cutters, improper angles, presenting the wood with the grain "wrong end to," neglecting to use guards, guides, etc.

Variety moulders are in many cases the most wretchedly designed and constructed, as well as the most abused machines to be found cutting wood. They will be found in many cases to consist of a light wooden frame, clumsy boxes, badly fitted iron spindles, cast-iron collars, and a warped table top, all without any regard to their ability to withstand vibration, secure strength, or produce good work.

I had an inquiry from a friend the other day, asking for about how much he could procure a "set of irons" for a variety moulder, he to make the frame himself. By a "set of irons," he meant boxes, spindles, collars, and countershaft. I would rather have those irons before he put them on a frame, than afterwards with the frame thrown in.

Now this is a wrong course to pursue, to get a good cheap variety moulding machine, because the machine builder does not, on account of the demand for a cheap machine, get up a first-class set of irons. He cannot in the very nature of things, get them up in as good shape or form as though he designed them for an iron frame machine, and as a majority of wooden frames are gross abortions, the whole job is a fraud from beginning to end.

I have never seen a wooden frame machine that kept perfectly true, and a variety moulder is worthless otherwise. There are several important features about these machines to be kept in view, when designing and building them, not the least important of which are a heavy substantial frame, well tied together to resist vibration; convenience of quickly raising and lowering the spindles to bring the cutter on a line with the work (this should be done without causing the operator to move from his place); perfect spindle bearings and steps to stand the high speed; independent tops to the spindles that can be easily removed, and different sizes used as the work may call for, or in a double spindle machine one can be removed, leaving the table-top clear for large sweeps; a perfectly true table with removable circular plates around the spindles, to allow the use of large collars, or even saws to be brought to the level or below the level of the table; steel collars properly grooved by an indexed milling machine, which are far superior in the matter of accuracy to any collars that are

planed; large belt surface on spindle pulleys with ample diameter to insure strong cutting power and high speed, and a countershaft having pulleys turned inside and outside and carefully balanced, and set nine or ten feet away from the machine. These points or features well designed and combined, will make a first-class variety moulding machine, which will do the best kind of work with reasonable care, running at a speed of 5,000, which will be found better than a slower speed, as the work is not so apt to catch or draw into the knives when at a high speed. The cutters should not present too acute an angle to the work, because they will be more apt to "catch" or "drag," and finish a rougher surface than if set to a more obtuse angle. I should have slots or grooves cut in the collars that would present the knives to the lumber at an angle of 55 to 65 degrees, as circumstances would require. Collars should be in sets of a uniform size, perfectly finished on the outside, as they form a guide for the work to run against. If rough they will drag on the work and heat. They should be a nice fit on the spindle, to prevent spring, and should have slots spaced all of an equal depth and distance from the center. For the same reason the tops of the spindles should be squared, for a wrench to hold securely when tightening or loosening the binding nut, and also for the purpose of removing the tops when desired.

Perhaps the most fruitful source of trouble about the whole machine, is in the manner in which most of the knives are produced and used. Many think it does not pay to get knives made at the shop, so they buy a bar of steel, have it cut in lengths, and then they make and temper their own knives. They generally have knives that do not balance, are of poor, uneven temper, and have bad edges, no two of which have the same angle, and they are not parallel. It would be found to be much cheaper and more satisfactory to have the bars first milled on the edges, at a machine shop, thereby insuring parallel lines and uniform angles, besides obviating any tendency to cant the collars and spring the spindles, by being drawn unequally on the knives, in which condition no machine can do good, smooth work.

They should run so steadily, that at a speed of 5,000 you can stand a new lead pencil on end between two spindles, without its vibrating or falling. This is a good test, and one that I have tried many times without having the machine fastened to the floor, except by its own weight. For the general line of work, knives should be drawn to a straw color and made from best steel.

CHAPTER XXVIII.

HAND OR BUZZ PLANERS, THEIR WIDE RANGE OF WORK AND GENERAL ADAPTABILITY.

THE hand or buzz planer, as it is now generally termed, is one of the very few machines used for operating on wood that has no power feed. At the same time it is a machine with which, perhaps, a greater variety of work can be produced than almost any other in use, with the exception of the variety or upright shaper. With it accurate surfaces can be planed, work planed out of wind, glue joints made, and squaring, cornering, bevelling, rebating, moulding and gaining performed, besides an almost unlimited variety of processes.

A little consideration in regard to this machine will convince one that the reason of its wide range of work is due to the same reasons that govern the upright shaper: its simplicity, fewness and accessibility of parts, and its ease and convenience of changing for different kinds of work, but above all these, as its chief one, its hand power feed. No power feeding machine could be designed to perform anything like such a wide range of work without being clogged up and rendered impracticable and almost inaccessible by the endless amount of mechanism, and even then it would not produce a quantity of work that would entitle it to be designated a labor-saving machine. One of the principal reasons that combination machines are an abomination is, that the amount of complication, time and cost of changing, overbalance the advantage derived from the increased variety of their work. In a simple hand-feeding machine like the hand planer, all that has to be done to produce different kinds of work or different forms and shapes is simply to add to or change the cutters and move the tables and guides, the latter taking so little time that it needs not be figured on. Like the upright shaper, it can, if properly proportioned and constructed, be run at a very high speed. This, in connection with the feed being at the will and judgment

of the operator, allows of very nice work being executed. Work that is done on very hard wood, uneven in its quality, or having a knotty or cross-grained surface, can be fed slowly and the reducing cuts made light enough to produce a superior surface, a thing difficult to do on a power feeding machine for standard work.

I remember the time when very few of these machines were in use. A few years ago when conversing with a cabinet and furniture manufacturer, in regard to hand planers, the idea was laughed at; who wanted to use a hand power machine in these days when every thing was done by power? The same man has now two buzz planers in operation. There is a limit to everything—even power feeding machines, and until some machine of that class is invented that will do as large a variety of work with as little complication, such ease of operation, and requiring so little care, there is little danger of the buzz or hand planer being supplanted. At the present time it certainly has not outlived its usefulness simply because it is a hand machine.

Hand matching machines are built on the same principle, and are the handiest little machines used in box or other factories where short stuff is required to be matched or jointed. They have not, however, the advantages of the hand planer as now built, in having an independent adjustment for the rear end of the table or tables. It is not really needed, as the front end of the table is usually rebated to about 1-16 inch below the rear end; this gauges the amount of cut which if found to be insufficient can be repeated until the joint is complete.

Hand planing machines are built by the various manufacturers in many different ways, all however designed to accomplish the same purposes. The parts that are so diversified are the tables. Each table front and rear requires two movements, vertical and horizontal. The movements are in some instances performed by the aid of cams, inclined ways, screws, compound levers, etc., each and all having their advantages and advocates. It is not my purpose to criticise the methods employed to attain the object, further than to recommend that which is best, viz: a movement that shall be positive and accurate, and remain so until a change is desired; one that is easy and rapid, and the least susceptible to wear and friction. The ends of the tables next the cutter head should be cut under to conform to the circle described by the cutters, thus allowing of a close adjustment, a matter absolutely necessary for the performance of smooth work on knotty or cross-

grained stuff. The edge of at least one of the tables should be rebated for the convenience of using such cutters. The cutter head should be small in diameter, and the perfection of mechanical construction to ensure smooth and quiet running at high speed; one end of the cutter head shaft should be so designed that cutters could be placed for any special forms, such as rebates, mouldings, etc., the extra heads and cutters could be easily and rapidly taken off or put on by having the outer cutter head box easily detachable. The fence or guide should always be secured to the rear or finishing table, thus avoiding any liability to come in contact with the cutters, and should be arranged to be set to any bevel from zero to forty-five degrees.

As a matter of convenience, the purchaser or user of a hand planer may be tempted to have an additional table placed on the opposite side of the machine and a hole bored in the end of the cutter head shaft for the purpose of having a hand planer and boring machine combined. With all such I would most earnestly plead with tears in my eyes if necessary, don't do it, you will regret it if you do. The advantages seem greater to the eye than are realized by practice. In the first place, a hand planer and a good boring machine bought separately cost but a trifle, if any more, than a good combined machine; secondly, the two classes of work are widely different and do not run together; thirdly, they cannot be used at once by one operator to any degree of profit; fourthly, they cannot be stopped and started separately, and if the operator wants to stop to sharpen or change the cutters in the hand planer, he must stop the boring machine also, and vice versa; fifthly, the ends of cutter heads that require such nice perfection in running should never be toggled with boring cutters which would only enhance the liability of springing or bending the journals; sixthly, the matter of economy of room is of but little moment as the extra machine takes but little space and can be more than compensated for by placing it to receive and deliver its work to better advantage, something that can be rarely done on combination machines that are so widely different in their processes. The tendency to complicate machines and make them universal, or machines of many kinds, is fast becoming extinct. It has been usually found to be a very much more costly way to produce work than with special machines made for one kind of work, or at least not many kinds of work, and then, only when they were similar in their processes and manner of production and operation.

CHAPTER XXIX.

BAND SAWING MACHINES.

OF the many various machines put on the market for cutting wood, perhaps none has made friends so rapidly, and been made so welcome, as the band sawing machine for ordinary work in cabinet, piano, and bracket factories, and car, wagon, and agricultural implement shops. Twenty years ago but comparatively few were used throughout the country, and now it is the exception to find a shop without one or more, and there are probably as many now built and sold as of any other kind of woodworking machines made. They are fast taking the place of jig sawing machines for any kind of sawing that comes within their range. They cut more easily, rapidly, and smoothly, have no jar, noise, or vibration of any kind, leave no pile of saw-dust on the lines marked for sawing, and are easily kept in good order at a minimum cost. They are simple in operation and construction, being of few parts, all of which are easily accessible. In fine as now built by many manufacturers, they seem to leave but little to be desired in the way of improvements. The frames have been designed to resist all tendency to spring or strain under the tension of the saws, and are at the same time light and out of the way of the operator for a large percentage of the work. They are generally designed somewhat like the letter "G," and with a hollow or cored section, to get the greatest amount of strength from a given quantity of metal. The tables are either wood or iron, and are so arranged that they can be moved on the radii of a circle whose center coincides with the line of the saw going through the table, allowing stuff to be sawn bevel or to an angle. Fences or guides can be used with good results, to assist in preserving straight or parallel lines, for slitting, etc.

The wheels for the ordinary machine average about thirty-six inches diameter, and have to be light and at the same time strong, in order to resist flexure due to strains, and to start and stop quickly without shock or jar. They are covered with rubber bands made in one continuous piece, stretched over the whole and cemented. This is done to prevent the teeth of the saw from coming in contact with the iron surface, and also serves as a

cushion. The larger the wheels are, the liability of having broken blades becomes less. The upper wheel should be so suspended in its bearings, that it can be canted over on a slight incline from perpendicular, to guide the saw to any part of the wheel's surface when required. The bearings should also have a vertical automatic adjustment as the saws require, either by springs or weights. Great care should be taken to change the amount of tension for the different widths of saw blades, as experience will suggest.

The art of keeping the saw blades of just the right tension for the different kinds of wood and work without breakage, together with keeping the blade filed and jointed in good order, are two of the most important requisites about the band saw. The attachments that generally go with each machine sold are so generally known, as are also their uses, that it would be superfluous to say anything here regarding them.

Some builders make a combination machine, that is a band and jig saw combined, or a band saw and upright shaper combined. Regarding such combinations it is perhaps safe to conclude that they are in poor taste and judgment. They hamper and complicate the machine, and destroy its simplicity. They cannot be used as separate machines are, that is—at the same time, but one has to wait for the other, and in almost every case the machine is not first-class in every respect. The cost is not so much less than two separate machines so that little is gained in that respect.

Perhaps one of the principal reasons that band sawing machines have attained their success is that saw makers have been able to produce saw blades that are reliable. Formerly it was the case that only French blades could be sold, but of late years, American saw makers have been able to produce an equally reliable and uniform blade. In fact they are just as much sought after and bring as good price as the foreign article. The band saw blades require peculiar treatment during the process of manufacture. When finished they must be hard enough to hold their cutting point well, and at the same time have that elasticity or ribbon-like quality that they will wrap around the wheels without cracking. They should be carefully jointed and filed, not too hooking, and without sharp corners in the bottom of the teeth. No saw should be so strained or inclined on the wheel as to cause it to back up against the guide and heat it. This is the reason of the upsetting on the back of saws. It also causes the saw blade to become longer on the back than on the tooth side in which case it is rendered worthless.

CHAPTER XXX.

JIG SAWS.

IT is a great relief to fret sawyers to see the designs in scroll sawing generally so made that they demand but very little inside sawing, which can be executed only on a jig saw. These inside scroll-sawn designs are becoming more scarce every day; less work is being done on the jig saw, and as a matter of consequence, more band sawing machines are used. It is a matter of congratulation that such is the case, for the jig sawing machine is one of the few machines used in wood-working establishments, that has its cutting stroke or movement arranged on the reciprocating plan, which is a plan having serious objections.

The cutting points of the jig saw cannot be run at such high speed as continuous cutters or saws ; and their proportion being about one to four or five, they will cut only at one-half of the stroke or revolution, the saw and pitman receiving their motion from the crank, come to a state of rest at each end of the stroke, and as a matter of consequence, cause considerable of a jar or shock in again starting another stroke. This is greatly augmented when the work is hard pressed against the saw.

The work can scarcely be expected to approach that state of perfection attained on band saws, because of the irregularity of the cut, and unequal tension of the springs that "strain" the saws. The vibration of a jig saw on a springy floor would give one the idea that an earthquake was rumbling beneath him. It is to be hoped that the fashions of trade will call less and less for the use of jig saws, but however much this may be desired, I presume that there will be jig saws for some time to come. There is not much to them, and as little to be said about them. They have but few parts and are well-known to the trade.

A shaft with tight and loose pulleys, crank plate and pin attached, driving a pitman rod and head, all situated under a table on which the work to be sawn is placed, with a suitable tension device for the saw blade hung from above, form about all the es-

sentials necessary to construct a jig saw. Many have a small blower or fan to remove the dust from the working lines; others have no fan, but kindly allow the sawyer to use his lungs and mouth for a blower and pipe; here is a chance for those who have so much spare wind to get it all utilized. It would be a grand scheme to have many of these high and mighty blow-hards placed opposite a jig saw table, to do their blowing where it would effect the most good.

The ingenuity expended on jig saws has developed many wonderful springs, pitmans, brakes, etc. The belt shifter as now generally made also carries a brake attachment to bring the saw to an instant stop when desired, both objects being accomplished by one movement of the foot. The pitman is at its best when made lightest, requiring less counterbalance. It is made generally of hickory and as light as possible; the pitman head contains the catch for the lower end of the saw blade, and the one made something like the claws of a hammer seems to be the most universally used, being easy to replace and also easy to get the saws in and out of for many purposes. It is better to have the table so arranged that it can be adjusted for bevel sawing.

The tension springs have but one duty to perform, viz., to keep as equal a tension on the saw as possible. They should with the upper guideways be hung from the ceiling perfectly plumb, with the guides perfectly aligned, that the saw will travel in the center line; they should be well strained with the rods and nuts made for that purpose, and the whole placed where the foundation is solid, if possible, with the excess of counterbalance on the crank pin side. To be successful, sawyers must soon acquire the art of following all sorts of irregular lines, curves, etc. To do this and keep saws in good order, quickly take them out and put them back, pick out loose pieces with a brad awl, and make smooth work, seem to be about all the necessary requirements. Surely it ought not to take. an intelligent operator a very long time to make a good jig sawyer

CHAPTER XXXI.

MORTISING MACHINES—VARIOUS KINDS—THEIR "SHOCKING" TENDENCIES.

THERE are perhaps no machines built for working on wood that have more different modifications than mortising machines. They are used for sash, blind, door, chair, cabinet, car, wagon, and numerous other kinds of work, and are modified for each particular kind. They have been the subject of an almost endless number of patents in each and every case, and are also the subject of a good deal of dissatisfaction regarding their operation to this day. Each kind or type of machine for the different purposes, has incorporated in its construction different principles and features. The machine as used by cabinet makers and carpenters for light work, has an eccentric or crank shaft as its moving power to the chisel-bar; the eccentric shaft has a fixed or permanent position, and the motion of the chisel-bar is continuous and positive, the wood having to be elevated to come in contact with the chisel. These machines are simple, having but few parts, and can be run perhaps at a higher speed than the other kinds. However, they are best adapted to light work, such as door, sash, blind, and cabinet mortising.

The second class is represented by the machine on which mortises are made by a revolving traveling auger, so formed as to work out the side as well as the end of the mortise. These machines are principally used for chair and special work, and are preferable where many pieces are to be exactly duplicated. The principle may be said to be the same as that of the ordinary routing machine, as is also its application to that class of work. In another class the graduated stroke is introduced, having its motion produced by varying the length of the connection from the eccentric to the chisel-bar, starting from a still point. This style of machine is used for different kinds of heavy work, or where the table is too heavy to be raised by the operator.

The above named are the principal kinds of mortising machines used, and are distinct from one another in their mechanical

movements and construction. There are other kinds, but they are but modifications of either or all of those mentioned, and need not be referred to here. The positive chisel-bar is used in some form in all of them except the rotary mortiser, mentioned for the chair and light work. The cutting movement of these machines consists in a series of positive and intermittent blows, and in this respect they differ from almost all other machines used for the finishing process in wood working, with the exception, perhaps, of the jig scroll saw. They also differ from them in being the most disagreeable machines to operate. They will jar and shake any ordinary floor like an earthquake, and almost pound a rock into fragments if placed thereon. They also have the faculty of being continually out of order, and calling for repairs. These faults are accounted for by the necessarily high speed at which they run, their numerous joints, and their reciprocating movement, all of which have thus far been unavoidable. They really seem to be more suitable for a pile driver than anything else. Many devices have been tried for the purpose of getting rid of, or at least, to diminish the shock or jar on the treadle, but thus far may be considered failures to a great extent. The only real cushion, and the final one, is the foot of the operator, and thence up through his spinal column.

When heavy work on hard woods is to be done, an operator will sometimes imagine that he is an inverted pile to be driven home by the treadle or lever. It is a good thing for the maintenance of mortising machines, that the human body is so elastic and cushion like If wood-working machine operators are ever to be commended, it is when they have the pluck to stand up and operate a mortising machine all day, or rather, allow the machine to operate them. Perhaps they are also to be admired for their patience in keeping the machine in shape, so that it will produce any work worthy of the name. There is a continual demand on its part for tinkering. The joints get worn out; crank bearing and shaft, ditto; and the chisels break or wear so that they drive more chips in tight than they loosen. They have to be "doctored" often to make them cut square with the work. The reversing movement doesn't reverse, or if it does it is at the wrong time. I think that if a machinist could have the exclusive charge of the repairs on twenty-five mortising machines, he could retire wealthy in a short time.

Unlike other machines, they do not complete their work, but leave part of it for others to do. They beat out a mortise, and

then the core or chips have to be drifted or driven out before the mortise is ready for a tenon, and on hard wood they have to call on the boring machine or attachment to start the job for them by boring a hole for a starter.

There is no doubt that many mortising machines are well de signed and built, but the trouble is, that the market demands square mortises, or at least, mortises having square corners. Why this is the case I do not know, for in the majority of work, round ones would be equally strong and answer fully as well. The whole difficulty lies in the fact that fashion demands work that rotary cutters will not produce.

I saw a little machine at the Centennial Exhibition, in which was a novel tool, or combination of tools, that would seem to solve the problem of producing a mortise without the jar or shock of a positive reciprocating movement, and yet give the same form to he mortise, besides finishing the job of cleaning chips or cores. Since then there has been a large number of them sold, and operated successfully on both light and heavy work with either an upright or a horizontal machine. I have seen them used by those who formerly used the ordinary kind of machine, and am informed that the comparison is not very favorable to the old style. I have examined and watched their operation for the past few years, and see no fault in the principle, or any reason why they will not eventually drive the reciprocating machine out of the market.

Without describing the machine in question, I will say that the cutting device consists of a hollow mortising chisel of the desired size that is stationary; that is, it does not reverse; this chisel is fast to the frame, and has oblong holes some distance from the cutting points. Inside this hollow chisel, whose bevel or cutting edges are on the inside, there is an auger or bit that is caused to revolve by its connection with the main driving spindle. The operation is simple: the work is placed on the table and fed to the cutters in the ordinary way, allowing the auger and chisel to enter the wood at the same time, to any distance indicated by the usual stop. That is all. The mortise is finished at one movement, and the chips are all carried out by the auger to the oblong holes in the chisel, leaving a mortise clean and true. The mortises can be made any size or shape that may be required. One of the many advantages claimed for this machine is, that a mortise can be cut very near to the edge without breaking out the surface. Something difficult to do in the ordinary machine.

These tools require no extra boring for hard wood, neither do they require the cleaning out of mortises afterwards. All is done in one operation. I am informed that they have been introduced in heavy machines, for car and other heavy work in hard wood, with the most satisfactory results. If so they will certainly take the place of the reciprocating machine, having all of the latter's advantages, and none of its objections. No good machine, with the facilities for producing work in a superior manner in a short time, and at a minimum cost for labor, and hard, disagreeable work, will lie dormant in this country. Users and operators of wood-working machines are too intelligent to allow of any such thing.

CHAPTER XXXII

TENONING MACHINES.

I WAS in Ritchie's sash and door factory the other day on a neighborly call, and during my stay the subject of tenoning machines was discussed. Among other things, Ritchie said he believed that with ordinary care, a tenoning machine would last for ever, nothing but a fire or an extraordinary accident could use it up. His sentiments as to their length of life might be modified some, but the machine certainly seems to be a long-lived one. In this respect it differs very much from almost every other kind of machine used to form or shape wood. I remember seeing Ritchie's tenoning machine when only a little boy, gathering shavings in my basket, and it now looks the same as it did then. It has the same old green painted wooden frame, with all sorts of fancy scrolls in red.

There is not much to cause a tenoning machine to wear out if we except the speed of the cutter heads, and they are so light and well supported by bearings, with the cutter-head pulleys between, that they have every advantage in their favor. Besides, the work done by it is comparatively light, even on heavy work, that is, the cutting is done gradually and slowly by hand, in contra-distinction to power feeding machines. It is true that some machines of recent design have been so arranged that the feeding has been done by power, but the proportion of work required of any tenoning machine is so small, that a very slow feed will enable it to keep up with the other machines surrounding it. Another reason that these machines last so long with common care, is that very few in the ordinary sash, door, and blind shops, are required to run more than half the time, and many even less than that.

The first tenoning machine used was supplied with two saws, one placed to cut with, or parallel to, the face of the work, and the other at right angles, forming the square shoulder of the

tenon. This operation was repeated on the reverse side, requiring two operations for each tenon. A few of these machines are still to be found about the country even now, and serve their purpose quite well, but of course the quality of work they produce, cannot compare with work done on a modern machine kept in good order.

The most popular machines of to-day for sash, door, cabinet, and other work requiring tenons from 1½ to 6½ inches long, are those having two heads whose center of rotation is parallel to the side of the tenon. The heads are so arranged as to finish both sides of the tenon by once passing between the heads. These heads are fitted with cutters shaped and ground to produce a drawing or shearing cut. This is necessary because of the wood having to be cut transversely to its grain or fibre, and its liability to tear off edges with straight cutters. The heads are also fitted with "spurs" or saw segments, to cut and produce a clean, square shoulder; these heads are mounted on a gateway frame, having slide-bearings so arranged that both heads can be raised or lowered simultaneously and also independently. They are provided with end thrust-bearings, to ensure perfection in length of tenons to the shoulder. The upper head generally has a lateral movement, by which on the single cutter head machines the length can be varied.

Many machines for heavy door and other like work have double heads, that cut two or more tenons on the same piece at the same operation, and within the past few years machines have been placed on the market that are double machines entirely, that is, they cut tenons on each end of the board at once. They are so arranged that all the heads on one end of the machine can be moved to and fro for different lengths of work. These machines are generally arranged to feed by power, and for an establishment having plenty of work to do, ought to be an economical producing, and labor-saving, machine. I saw one fitted up with cutters, etc., that was turning out an almost endless variety of work. Besides cutting tenons, it would cut square off and mould both ends of table leaves and other work, making it one of the most valuable machines in the factory. These machines also have the advantage over single end machines of producing tenons that are square, parallel, and exact duplicates in length, a matter of great importance when the pieces are put together. The cope heads are generally so disposed that they can be adjusted with the tenon heads, and no machine is complete without them when used for

sash, door, or blind work. They are also coming more into use in cabinet work.

The hold down is a simple arrangement, and need not be noticed here. The table is one of the parts of a tenoning machine, on which the operator depends for square and true work, or rather, I should say the movement of the table. If it does not travel square with the line of the cut, the result is obvious—the work is not square. As a general thing, the slides are none too long to produce and retain a true bearing on the track or ways of the frame. Tables also have the fault of being hard to move without considerable exertion. When they are only moved by great power, the work is forced up against the cutters suddenly, causing the cutters to do too much work at the expense of quality. It seems as though this might be avoided, if some means were taken to obtain an anti-frictional slide.

Some builders have made a partial attempt in that direction, by placing rollers on the track next the cutter heads. This does not accomplish the desired object, but only tends to aggravate the trouble when the table becomes worn, because one end is liable to lead the other in traveling, and not only binds on the other end, but produces imperfect work. Rollers should be placed on both ends or tracks, and thus equalize the wear and cause the table to travel easily. They could also be arranged so that they would provide for wear and proper adjustment.

For heavy work, machines that have a fixed or stationary table and movable heads, are now preferred to those of any other kind, and are coming into more extensive use every day. It is found that they are more convenient, as it is easier to move a light part of the machine than the large heavy timbers. They are also much quicker in their operation.

CHAPTER XXXIII.

MOULDING OR RE-LINING BABBITTED BEARINGS.

PROBABLY there is no class of repairs so often demanded as moulding or re-lining babbitted boxes or bearings, and this is more particularly the case in establishments where wood-working machinery is used. Several reasons may be assigned as the cause of this, among which may be named, first, the very high speed at which the large majority run; poor babbitt metal; the use of unevenly tempered steel for spindles; poor means of lubrication and protection from dust, grit and other cutting substances; and inattention or neglect on the part of those whose duty it is to care for them. It is often the case that this class of repairs can not be conveniently taken to the machine shop on account of distance and consequent delay, neither is it necessary, for while in many cases it is a job requiring good skill, judgment, and experience, yet with a few cheap tools it can be done by anyone who will carefully observe and practice the few following suggestions.

Before going into the *modus operandi*, however, I would say that on many accounts it is perhaps best to purchase the metals from some reliable dealer and state just what use it is to be put to. Babbitt metal for high speed spindles, such as cylinders or planers, upright shapers and the like should be the very best, composed of one part copper, two parts antimony, and twenty-two parts banca or other good tin, while for ordinary bearings such as on line and counter-shaft boxes a metal composed of about two parts antimony, five parts tin, and eighteen parts lead is better than nine-tenths that are used for those places. The difficulty in melting and mixing the first named in any ordinary open fire is due to the fact that the copper takes a very high degree of heat to melt it, and the antimony is liable to sweat or burn out before all is thoroughly melted and mixed. They can be successfully melted in a crucible carefully covered and in a strong fire—the copper melted first, then the antimony, and the tin last. Care must be taken to avoid loss by oxidation or exposure to the open air.

The first thing to be considered in re-lining the bearings is an examination as to the cause of the old one giving out. If it is found that the shaft or spindle is out of truth or has sprung, it will have to be made right before going farther. A shaft out of truth or round will of course have to be re-turned to truth, or if sprung will have to be straightened. This last operation can often be performed on the spot by springing it back to truth and testing it by trueing it up by hand. The old babbitt can easily be taken out by the aid of a cope chisel cutting lengthwise of the bearing, or by melting, as the case may be. After this is accomplished, the bearing should be thoroughly cleansed of grease or other foreign substances, and carefully dried to avoid any accumulation of gas when pouring. If this precaution is taken there will be fewer blow holes or rough uneven surfaces in the bearing.

The next operation requires care, and some fine measurement if the bearings are fast to the machine, therefore a special arbor or shaft should be used, about $\frac{1}{100}$ of an inch larger than the spindle proper, in which case springing of the spindle will be avoided, and the bearings found to be of the right size without any fitting, the difference in size being compensated by the shrinking of the metal. In either case, the spindles, when put in place, should be set accurately, parallel with the bed and square with the framing or other parts that they may have to work to; then cut out "liners," either of pasteboard or soft pine, which latter is preferable, as it can be reduced in thickness, and thereby take up any wear; cut these of the length of bearing and to the shape of the outside, the inside edge being straight with the shaft and having several **V**-shaped notches cut for the admission of babbitt to the lower half of box or bearing. After cutting holes in the "liners" for the several bolts, the shaft is ready for the placing of the cap which must have a hole from ½ to ¾ of an inch diameter for pouring into; next, lute up the ends with clay or putty, and build up a "pocket" of the same material at each end of the bearings; this allows the gas to escape; also form a pocket around the top hole to prevent spilling and waste. If the shaft is for a loose pulley or other "solid" bearing, it should be lightly painted with a mixture of lampblack and lard oil, and have two holes drilled in the bearing or hub. Coating the shaft allows it to be easily withdrawn after pouring, and the additional holes are to prevent an accumulation of gas. The absence of suitable "vents" will produce formation and accumulation of gas, which keeps the metal

bubbling, and often blows it clean out of the bearing. I have seen this occur quite frequently, and in one case saw a person lose one of his eyes as the price of his forgetfulness.

After having gone through these processes and taken the proper precautions, the next thing to do is to melt the metal. Right here I would say that more babbitt is spoiled by being melted too fast than most people think. It must be melted slowly, and the harder the metal the slower it should be melted, because hard babbitt metals contain certain proportions of different metals that take a great deal stronger heat than others. The tin will melt first, antimony next, and copper last. These metals have each a different specific gravity or degree of weight; antimony being the lightest will float to the top and become burned or sweat out before the copper is thoroughly melted. To avoid this the moulten metal must be well covered with charcoal or a lid, and just before removal from the fire be thoroughly stirred or mixed up. When taken to the bearing, everything being ready, pour the metal as rapidly as the hole will receive it, and the faster it is poured the better the results will be, therefore I advise large holes for pouring into. After pouring, remove the bolts and tap the caps lightly with a hand hammer, or raise them with a chisel or wedge. This is necessary because the babbitt has a solid connection at every one of the V-shaped notches in the liners; dress these all off even with the surface of the box joints; rub a little red lead on the spindle and put it in place; revolve slowly by hand; then remove the spindle and file or scrape the high spots; repeat this until the red lead shows a good bearing surface, then drill out the oil holes and cut the oil grooves.

If spindles, instead of special babbitting arbors, have to be used to pour the metal on, they should be examined to see whether they have been sprung, as is generally the case. After getting them straightened, put them in place, bolt on the caps until the spindle will revolve easily without shaking, and the job is done and you are ready for business. If it is done well, thoroughly, and properly, and if the other parts are as good, it will give good results.

Boxes should never be cast in halves as they will not be round, and it is not easy to get one half in line with the other, besides it is well known that hot babbitt metal poured into a lower half of a bearing, will raise the shaft out of place unless it is secured there. The pocket for pouring into should be filled at least part way, to allow enough metal to fill the drilled hole, as the metal settles some by shrinking.

Surplus metal left in the ladle should be either covered to exclude the air until cooled, or poured into a form or mould and likewise treated. The smaller the pieces are broken into before melting; the faster and easier they will melt. A good way to test whether or not babbitt is hot enough to pour, is to insert a small pine stick, and when it becomes charred (not burned or in flames) the metal is hot enough. It is a good plan to get boxes or bearings warmed up enough to take the chill off them in cold weather.

I remember when I was a new hand at the bellows, of once having to line a large box six inches in diameter. Having no mandrel on which to pour, the foreman directed me to make one out of a hard piece of beech-wood. I did so, and put the box together properly. Having to use two large ladles I innocently took the last "trick." The result was, that I was all covered with babbitt metal: my arms all blistered, and my clothes full of it. I tried it again and again with the same result; finally an idea dawned on my mind; the last ladlefull always did the mishief, but I could not tell why. So when ready to make the fourth attempt, I reported to the foreman, who examined my method and found it all right. I seized the first ladle and poured it, leaving the last to him, and before his was half empty he received a bad dose, dropped the ladle, and started for the water trough to cool off. He then advised me to pour in separate halves. In doing so the metal did not fly, but there was lots of hand-fitting on that box, because the wooden mandrel got badly out of shape. I afterwards learned that there is more moisture and gas in wood than in iron.

Moral: Never use wood or any kindred substance for a babbitting arbor.

CHAPTER XXXIV.

LOOSE PULLEYS—RESULTS OF OBSERVER'S EXPERIMENTS.

ANYONE who has had to do with machinery, and particularly wood-working machinery driven by belts, knows well the trials and tribulations of loose pulleys. They are always rattling, squeaking, and cutting out; they have a faculty of making trouble when least expected or desired; and sometimes they do not cut out, but take a notion of cutting or grinding fast to the shaft, in which latter case they make excellent fast pulleys. If we take the average speed of loose pulleys on wood-working machinery we must conclude they are "fast" anyway. When they become loose on the shaft and are allowed to continue to wear the shaft out of round and size, and often grind the edges of the rim "wobbling," they will take more oil and throw it out than a good-sized faucet at full head. They are a source of annoyance to all within their hearing, the range of which is not small by any means, and they are a prolific means of developing "cuss" words from those who may happen to have them under their immediate charge.

There are a great many reasons for the above-mentioned grievances. The machinist perhaps is at fault: He does not get the shaft round; it may be too tight, and cut fast; it may be too loose and throw the oil out so fast that it does no good; the shaft or hole in the pulley may be out of round, or the pulley may be improperly balanced or not balanced at all; or it may be that the pulley has been turned even larger than its mate—the tight pulley, in which case the belt must be unusually tight. It may be that some "genius" has been selling oil that would better fulfill its mission if used as a substitute for glue, resin, molasses or other sticky substances, and the operator who doesn't know or care why a pulley doesn't run quietly and smoothly has used it as a substitute for set screws. If the pulley has simply a plain oil hole connecting with an oil channel cut lengthwise in the hub, the chances are that the hole will be allowed to clog up and the channel get full of gum and other refuse, so that the oil can neither get in nor

out; if it has an oil cup attached the feed stem becomes filled and obstructs the passage of oil; if fitted with a self-oiling sleeve no attention is paid to it until it calls for replenishing in very decided terms, not altogether agreeable to the ear. I might also add that very often the owner is responsible by purchasing something called a lubricant, which is really unfit to use for greasing a barn door hinge. These and many other reasons combine to make what is really in fact as well as looks a small thing for consideration, and yet one of the most noisy and objectionable pieces of machinery about the whole establishment, and the trouble is that there are generally a number of them and no two turned alike. There are ways and plans by which to repair all things, loose pulleys included.

I was in a furniture factory some time since where a loose pulley on a variety moulder counter shaft was just howling for all it was worth. I asked the foreman why he did not sell it for a steam calliope, or rent it for a full brass band and orchestrion combined, to a beer garden proprietor. He said he had got tired of putting it in order. I ventured to inquire whether he had ever done so or if he knew how? Just did know! Just take that pulley off the shaft, knock out the babbitt, put the pulley back on the shaft, and fill it with babbitt again; then punch the babbitt out of the oil hole, put on the belts and go ahead—that is the way to relieve a loose pulley. One thing was certain—he had not taken off the high spots or filled up the low ones that the pulley had made on the shaft by continual pounding, but he had sprung the shaft worse every time he had poured babbitt on it, and he had to drive the pulley off with a sledge because the shaft was neither round nor parallel, and in getting it off he had to cut the babbitt surface until it was unfit for use; then he had to file out the hole until the pulley would go on again. When it was on it was all kinds of a fit—sometimes tight, sometimes loose, just as it happened to touch the high and low places on the shaft. He was finally induced to take the whole thing, shaft included, to the machine shop, and get the job done properly. First, the shaft was straightened and the part that carried the loose pulley was turned round and true. As this reduced the shaft to an uneven size so that no regular arbor could be used to pour the babbitt on, an arbor considerably smaller was placed in the hole and wedged to the center; the babbitt was poured in and the pulley taken to a lathe and bored out to the odd size; then an oil hole and channel were put in, and the pulley tried for balance and size relative to the tight

pulley; these found to be correct, they were taken back to the factory with instructions to either oil often and *carefully*, or put in a brass oil cup, but never to let it get empty or clogged up and he would have no trouble. He has had none since

No operator ever had a loose pulley give out but would inform you that he had just examined and oiled it a short time before. This may or may not be so but it does not matter either way, because it was not the neglect for that one time that caused the trouble, but the *continual* lack of oil and vigilance. This is the price of success with loose pulleys. A plain pulley should not be floated in oil, but it should have a little oil at a time and very often, according to its duty. If an oil cup or self-oiling sleeve is used, it should be examined every day to see that it is not clogged or the oil run out, until you find out just how long it will run without filling, after that it need not be examined often, but be sure to be on hand first. Don't let the oil travel faster than you do; this is the secret of smooth-running pulleys. If you find that it will feed ten days without replenishing, do not wait ten days and one hour, but fill up again before nine days are up.

I have made a great many different kinds of loose pulleys. First I tried the ordinary old way of lining with Babbitt metal, but found that they would cut out; then tried a self-oiling sleeve made of bronze (brass) metal that would fit the pulley at either end, and form a recess holding from a gill to a half pint of oil, cut two V slots lengthwise in the bush, filled it with felt or wicking, and secured it in place; then drove the bush home and awaited events. Some users said it was the best thing ever was—would run a month without filling; some said it was no good—the oil would not feed through; others said it got heated, and the V slots opened and let the oil out too fast. I had not the shell thick enough to resist expansion and opening of the slots when heated to an immoderate degree; that was my fault; neither had I figured on an oil being used that could not be strained through anything finer than a coal sieve. I suppose that was owing to my ignorance of the real value and virtue of cheap "black strap" oils. I must say that I was not greatly encouraged. However, I struck another idea. I made patterns for another "self-oiling sleeve" for loose pulleys. This time I put four ribs on the outside of the sleeve for strength, each about $\frac{5}{16}$ high, two of them $\frac{3}{8}$ inch and two $\frac{3}{16}$ thick; these ribs, and the flanges on either ends, made a bearing for the hole of the pulley, and gave considerable back-bone to the sleeve; the two thick ribs had holes $\frac{5}{16}$ inch diameter, extending almost

through them, spaced every $\frac{3}{4}$ of an inch apart the whole length, and these $\frac{5}{16}$ holes were merged into holes $\frac{1}{8}$ inch diameter, which extended through the rest of the rib. Every alternate hole was then drilled from the side of the rib, at right angles to the first or upright holes, the first one on one side and the second one on the opposite side in the second hole. This was for the purpose of feeding oil, no matter whether the pulley went forward or backward; the holes were all filled with felt or wicking as before, and then I awaited criticisms. They soon came in. Some thought that perfection had been attained, as this was simply perfection—they could use this rig where all others had failed; others evidently supposed that it did not need to be filled except each New Year's day, and the oil so cold that it had to be cut up and pressed in, a chunk at a time; others said that it would not feed the oil. This last assertion staggered me, as I had put the side holes in supposing that the high centrifugal speed would virtually pump the oil through the hole and on the bearing. I wish Congress would enact a law empowering me to carry a many-barreled shot gun by which to exterminate the oil fiends who deal in those cheap black oils, or at least confine their sales to saw-mill men to grease logs with, or to small boys who could use it for sliding. It goes without my saying, that the last sleeve was as good as could be used on any loose pulley, but its failure was due to the fact that it *would* need to be re-filled some time, and would not feed anything through but oil—by oil I mean limpid grease, pure and unadulterated.

My next venture was a plain cast-iron hole in the pulley, bored true and smooth, having the hubs at least $\frac{1}{4}$ longer than the rim was wide; thus for a pulley four inches face, make the hub five inches long; pulley six inches face, hubs $7\frac{1}{2}$ inches long; pulley eight inches face, hubs ten inches long, projecting equally on both ends; after boring a straight hole I had a recess bored in the centre of the hub at least $1\frac{1}{4}$ inch long, and $\frac{1}{4}$ inch deep for oil, and the usual oil channel cut lengthwise of the hole to within $\frac{1}{4}$ of an inch of each end; then put in an oil cup leading to the recess, and having a feed hole in its stem of ample size, say $\frac{1}{4}$ inch in diameter. I did not wait for anyone's opinion or judgment this time; I knew that they would not be any more flattering than the previous ones, but I felt satisfied that the results would be all right as the principles were correct. In the first place, the extra length on the hubs was worth more than all the rest of the hub put together. It gave more bearing and

served as a brace to the rim, resisting any tendency to tip when the belts were shifted or placed on one edge of the pulley. Second, the recess was large, as was also the hole in the oiler, and would feed almost anything that would flow or run; and third cast-iron was as good as any metal for a bearing, if of the proper dimensions. Being of a porous nature it soon glazes over and makes a smooth hard surface, and will wear an indefinitely long time.

A loose pulley should always be considerably smaller than the tight one, in order to relieve the belt when idle, as well as to save wear and tear on the shaft and pulley, and save oil. From 3/8 to 3/4 inch diameter has been found to be about the average in difference, as it virtually lengthens the belt from 1/2 to one inch, which is a great relief. Pulleys have been and are made with a difference of from 1 1/2 to 2 inches diameter, in which case they have either bevelled or vertical inclines, or flanges.

The objections to the latter are, that they shift a belt too suddenly, and cause considerable strain, and consequent slipping and burning, and also spoil one side of the belt by extraordinary stretching on that side. For saving shafts from wear or reduction in size where there are other pulleys or bearings between the loose pulley and end of the shaft, a good idea is to bore and fit a sleeve of cast-iron fast on the shaft on which to place the loose pulley. Nothing wears better under such circumstances, than cast-iron, and it is comparatively cheap and easily replaced.

There is nothing about the whole job that vexes one more than to find it necessary to reduce the shaft in order to get it true for the loose pulley, and to find that all the other pulleys outside of it must be re-bored and bushed, and the outside bearing re-lined with babbitt, in order to allow one loose pulley to be placed in position. A cast-iron sleeve will effectually obviate these difficulties.

CHAPTER XXXV.

LUBRICATION OF WOOD-WORKING MACHINERY BEARINGS.

WEBSTER gives a definition of the word lubricate "to make slippery or smooth." As regards machines of any kind, it means to pour oil so that it forms a film between the revolving and the stationary parts, or in other words, to separate the contact of shaft and box, and *vice versa*. No bearing that has not this film or coating of oil or grease extending over its whole surface, is lubricated sufficiently to do its own work well and easily. The object of lubrication is to keep metal surfaces from contact with one another, and thus avoid abrasion or cutting. This abrasion is caused by high speed, heavy weights, and dry surfaces coming together. If you will take a new spindle and bearing perfectly fitted, and before oiling it attempt to turn it by hand, you will be astonished to see how much more power it requires than to turn it after giving it a slight dose of oil. An experiment of this kind will illustrate the value of lubrication as well as anything else known.

There are so many kinds of bearings, in various conditions, performing so many different duties, that it would take more space than can here be spared to treat of them, but a few words as to the ways and means of lubrication may not be amiss. There are upright and horizontal bearings; bearings neither upright or horizontal; bearings long and short, heavy and light, of high speed and slow speed, accessible and inaccessible, and I might say unseen, in the matter of lubrication. There are many of the last mentioned that suffer, not through any fault of construction, but from lack of attention and care. Some argue that different kinds of oil will do for different places or duties, as for example, one would use one kind of oil for a heavy, slow-running bearing, and another kind for a fast, light-running one, and still another for one that was fast and heavy running.

I would simply say that the man who tries this will run an oil store, having his machinery merely as an adjunct, or using it as an object on which to experiment with oils. He will not have much time for anything else. It may be that an oil is sometimes found to do well on a light-running spindle bearing that would prove a failure if applied to a heavy, high-speed bearing, but I want to see that kind or brand of oil that performs its duties perfectly on a high-speed, heavy spindle or shaft, that will not do equally as well on a light-running spindle. The fact is that it will do vastly better and at less expense and trouble.

The principal quality required in lubricants is grease, simon-pure and unadulterated—a grease that, while limpid enough to run into every part of the bearing, will have body to hold itself there until worn out. There must be an absence of all acids, resins or gums, as, no matter how limpid an oil is, if it contains a small percentage of grease, it will wear or last only as long as that percentage lasts. If it has been "doctored" with any gummy or resinous ingredients, it will soon show itself in the increase of power required to revolve the shaft, and will also heat and stick like glue.

A great deal has been claimed and said regarding the lubricating qualities of the various oils lately presented to the public, but they are in many cases anti-lubricators. A gallon of sperm oil, or perhaps two gallons of the best pure lard oil, will go as far as twenty gallons of many other so-called lubricants. About as good and thorough a test as can be made, is to get a large pane of glass about twenty inches long; place it on an incline of about ten degrees; pour on the upper end of the glass, side by side, a drop each of pure sperm, lard, and any of the cheap mineral oils; cover from dust, and examine them at intervals of first, four or five hours, then ten hours, then twenty hours, then thirty hours, and note the result. On the first examination you will find that the mineral oils being diluted to make them limpid, had run off at the lower end, or else were so gummy that they had all stuck on the glass, while the lard and sperm oils were still moving. the lard oil continuing to do so until the end of the fifteen or twenty hours, and the sperm until the expiration of thirty hours. This places these oils in the following ratio for value as lubricants: minerals, one; lard, three to four; and sperm, six to seven; with a difference also in favor of the last two named—they do not "stick" everything fast, and one drop of them will do where ten to twenty of the poor substitutes are required. If

any one doubts this statement, all I have to say to them is, "try it." I have been lubricated and stuck by cheap oil and oil men, and know whereof I speak. These facts only go to prove the truth of the old adage that the best is the cheapest.

There are almost as many ways and means by which to get oil into bearings as there are kinds of oil, and some of them are mean ways too—notably, the self-feeding oil chambers or cells attached to, or part of the boxes or bearings. I prefer the term "cell" to "chamber" because it is more significant; they are in a majority of instances "sells" in more than one sense. They were designed by their inventor to relieve the operator from any care whatever for some time after filling them up. I don't know of any other device on machinery where the design of the originator has been so fully carried out as on self-oiling chambers. The operators generally do a great deal more with them than the inventor could do or would even think of doing. They can fill one and use it until the bearing is *worn* out, and sometimes it doesn't take long either.

The great trouble is that oil chambers are filled up and forgotten until they become dry and melt the bearings, but no matter how carefully and often they are attended to they will not feed poor oils. Capillary attraction doesn't attract thick gummy substances worth a cent. Sometimes, however, it is almost impossible to use anything else but self-feeding oilers, on account of the location of the bearings. Where this is the case I would say, use good oil, keep it clear of sediment, grit, etc., keep chambers as nearly full as possible, and trouble will be reduced to a minimum in that direction.

Where a bearing cannot be got at easily or often, if practicable, a glass oiler is as good a thing as can be used to conduct the oil to it. A glass oiler has the advantage of the oil chamber in holding a quantity of oil, and can be regulated to the wants of the bearing, and is always in sight. One can tell at a glance how the oil supply is, and whether it is being fed out too fast, too slow, or just right. These glass oilers are also handy to take off and clean out. It is sometimes the case that they cannot be used on account of their liability to breakage caused by stuff being thrown against them with considerable force, as, for example, boxes of cylinders on planing machinery, or the arbor boxes on re-sawing machines, etc. These bearings require plenty of oil and a reserve supply on hand, and as oil cups cannot be used with any safety, most builders use oil reservoirs cast on the top of the cap. This

cup can be made to receive a sufficient quantity of oil to last considerable time, besides leaving room for tallow or suet—something that should be put in all oil reservoirs where high speed is attained, as it does not melt while the oil lasts and does its duty, but can be relied upon to melt down into the bearing when the oil gives out. It is also a good lubricator.

Oil reservoirs of this kind sometimes have a cap or cover made of iron or other metal. This cover gets loose, the hinge pins come out, and it drops, either into the shavings, or into the cutters, which is much worse, and causes great damage. A better plan is to make the reservoirs higher and fit wooden caps or plugs to go on the inside of the hole; they do no damage if they jar out, and can be easily replaced if lost, while any ordinary wood turner can get them up so as to look a great deal neater than even a metal cap. They are also much cheaper to fit up.

It has often been noticed that slow running journals give more trouble and actually wear out faster than fast speed bearings in many cases. For instance, the bearings on feed rolls run very slowly (from thirty to sixty turns per minute) and yet give out very fast. Three causes may be assigned for this: first, they run so slowly that they will cut or stick fast before they heat enough to be discovered in time; second, their slow running induces oversight and neglect to oil often, whereas the high speed bearings are attended to promptly; and third, there are very few of them that have not large gaping oil holes that serve as avenues by which dust and grit are introduced without stint or hindrance.

No oil holes should be allowed to go without some kind of a plug or cover. They must be protected from anything that tends to produce abrasion or cutting of the bearings. To assist in keeping journals or bearings well oiled and cleaned, a good plan is to insert pieces of felt or wicking between the joints before screwing together; they will hold oil and wipe off foreign substances at every revolution. When liners or packings of wood are used between the box and the cap, the wood can be cut back from ½ to ¼ of an inch, and the felt placed therein and against the spindle of the shaft.

Very little value can be set on traps or other devices for catching oil and using it over again, even if the best of them are used. It has been generally conceded that a good lubricating oil has among its other good qualities, the faculty of staying on the bearings until it is used up or worn out, therefore it is worthless afterwards and should be allowed to run off or out of the bearing

where it can, if desired, be received into a waste cup, for the sake of cleanliness. For similar reason, it is the best plan to oil any bearing from the top. Oils are commodities that are greatly wasted. There is perhaps ten times as much poured out as is ever used. If a few drops were placed on at a time, and more often, there would be less oil wasted and machines would look less like having been tumbled around in a soap vat. I must not be understood to advise using oil sparingly, but urge that it be used judiciously. Oil often, freely, but not wastefully, keep oil holes and cups clean and covered, always remembering that the little particles of dust and grit which are always flying in the air are the gods that grind and cut bearings, sometimes not very slowly, but always surely.

CHAPTER XXXVI.

A CHAPTER OF ACCIDENTS.

ON the assumption that "self preservation is the first law of nature," I feel justified in calling attention to the various causes through which accidents happen to operators of wood cutting machinery. There is no class of mechanics that run a greater risk of meeting with accidents, than these operators. The reason of this is easily understood. Fast speed, sharp cutters, exposed belts and gears, unprotected saws, projecting set screws and bolt heads, and the improper fastening and balancing of cutters, are a few of the many causes that lead to the destruction of property, and cripple or cause the death of those employed in these establishments. Without constituting myself a jury to pass judgment on my fellow men, I may claim without fear of contradiction, that a majority of the accidents are directly traceable to some one's neglect or carelessness, and very often that same one pays the penalty with his own life.

The very places and parts of machinery that one would suppose to be the most fruitful sources of mishaps, are found to be comparatively innocent of such charges, because their danger has been well-known by those who have to be near them, and therefore take the necessary precautions. One seldom hears of persons getting caught in a fly wheel, because they know the danger, and keep at a respectful distance; few get hurt from a flying knife or cutter, because it is securely bolted in its place, and carefully watched when started in motion. Heads and bodies are kept out of the way until one is assured that there is no danger. The little innocent, and seemingly inconsequential things are the ones that do the mischief, coming when least expected from an unexpected source.

One great fault, and one that causes numerous accidents with many workmen, is the manner in which they attempt to put on belts while pulleys are under motion. More people get caught in belting by attempting to do this thing than in any other way. I

have seen men on a ladder trying to put on a ten inch belt running at high speed, crowding the belt against the pulley and burning it as well as their hands, and finally having to give it up as a failure; then they had the speed slowed, and put the belt on without any trouble. I think that they never calculated how fast they would have to move the belt to get it on easily.

There is nothing that agitates my nervous system more than to see some one attempt to put on a belt while standing on the wrong side of the pulley. He stands no chance of getting the belt on, and a good big chance of being caught and wound up around the shaft. The proper place is to stand on the opposite side of the belt, putting it on as it travels towards you. Having a good foundation to stand on, take the belt in hand and lead on to the pulley, moving the hand as fast as the pulley travels. This is the whole secret. I have seen a little fellow who understood this principle, go to a large belt that three men were tugging at and easily put it on the pulley at the first trial.

Pulleys on line and other shafting should never have any set screws so placed as to be likely to catch clothing or belts; they should be well under cover and no longer than required. For cutter head pulleys in exposed places, keys should not be left out beyond the end of the hub, nor set screws project beyond the surface. They cut nearly as badly as a knife and are more dangerous because of their exposure. I remember seeing an old operator who had two of his fingers shortened up considerably just from this cause.

Variety moulders are very blood-thirsty sometimes when cutting cross grained or eaty stuff, but all such danger can be avoided by using one of the many guards now in the market. The same may be said of saws. Within the past few years there have been numerous devices put on the market, but any one if so disposed, can make them equally as good for all practical purposes. The writer would also recommend the housing or covering of belts wherever possible, if they are dangerous. Having been "knocked out of time" by the parting of a matcher belt, he knows how it is himself. One ounce of prevention is better than a cart load of cure.

Don't allow your fingers to get any nearer the cutters than stern necessity compels, and keep as far away as possible to do the work easily and well. In this connection I want to speak of an incident that happened "once upon a time." A man went into a joiner shop, and not seeing anyone about, he went up to the saw

table where there was a bright new saw in motion, but it ran so smoothly and quietly that he laid his hand on it to feel of it. He left a finger on that table. Just then the owner came in and seeing him dancing around with his hand all bloody, he asked him what he had done and how he did it. Advancing to the saw he said he had just put his hand on *so*. By gosh! there goes another finger. He had no doubt as to whether the saw was revolving or in cutting order either. I venture to say that since then he hasn't "monkeyed" around any saws.

I was shown a board nailed to a post in a factory not long since. It showed the marks of saw teeth, first very close together then gradually extending apart until they coincided with the distance of the saw teeth. This board had been fed through once, and was being passed back over the saw to be ripped again. It was allowed to touch the top of the saw which threw it with such violence as to instantly kill the man who was feeding the saw. What right had anyone to pass a board back over the top of a fast running saw; what right had a saw to be thus unprotected? Evidently, the first law of nature was not observed to an alarming degree in this instance.

In talking with an operator who had run upright shapers, he showed me his hands on which he had neither a whole finger nor thumb. He said that they had all been lost either through inattention to his work, or feeding against his judgment. Dull tools, cross-grained stuff, and inattention will always make trouble around an upright planer.

I was in a planing mill the other day and saw a man shifting a feed belt on a planer from the tight to the loose pulley with his foot, in spite of the fact that he nearly lost his life and did break his leg in two different places, only five months ago. You see, it would have taken too much time and lumber to erect a suitable shifter. I saw another man get his fingers cut very badly on the cylinder, by starting up before he was ready. His shifter was made only to push the belt on to the loose pulley. He probably did not think it just as necessary to keep it off after it was shifted. He has altered his opinion, however, as I notice he has the proper kind of a belt shifter and lock to hold it in its place.

Another operator could not get the last board out of the machine fast enough, and intended to help it some by bracing his foot against the under cutter and pulling it out. He does not do that way now, because he has only one foot left, and the other leg has only a heel at its lower extremity. He feeds a piece of waste

stuff far enough to push out the last board. This way is much easier on the muscle, and less liable to result in the destruction of the pedal extremities.

Another case was that of a man who set up a large flooring machine and put in a suction pipe and a box of stuff ⅜ of an inch thick to take the shavings from the under cutter. He made the pipes so small and the curves so near a sharp angle, that the pipe was often clogged up. Every time it was clogged up, some one commenced to "kick" against the box. The boss came along one day when the box was clogged up; he kicked pretty hard and effectively, and also too high. He does not kick much to speak of now, because he has only one foot. The knives were not dulled much, neither was any part of the machine damaged. The strongest survived, if not the fittest. I beg leave to add that he now has a suction pipe that is properly made, and large enough; besides it is of ample strength to resist any amount of kicking that either man or mule can perform on it.

CHAPTER XXXVII.

FIRES, THEIR CAUSES AND THEIR PREVENTIVES—BROWN'S EXPERIENCE—ORDINARY PRECAUTION AND THE BENEFITS RESULTING THEREFROM.

IF there is any one thing that produces larger losses to the wood-working factories and planing mills than any other, it is without doubt fire. Almost every trade journal relating to this branch of business has a column devoted to casualties, and the greater part of it relates to fires. Fire is an evil agent that is liable to pounce upon us at any time, and from any part of the building. It makes no noise, and gives no alarm; does not have to be assisted to any great extent, but proceeds to get its work in quietly, surely and effectively, and in most cases succeeds to an alarming degree. In wood-working factories of all kinds which I have noticed, there are, to a casual observer, many paradoxes. Effect does not follow cause, and correct theory does not result in correct practice, at least these results do not seem to be in any hurry whatever to assert themselves. This is rather noticeable in the case of buildings devoted to wood-working purposes. You may step into a building, and after careful observation conclude that it is a nice, clean, well-kept factory, provided with all proper means to prevent and resist fire. Well, if you do, you have either got into the wrong door, or else have drawn a lucky number. The chances are that the next nine you go through will be just as bad in their appointments, or rather lack of appointments to prevent a fire, as this one is good, but they will have all that is required to start a fire of any kind, either a small one that is capable of growing fast when started, or a full-fledged one that will lick up everything in a shorter time than you would take to eat a lunch in. There are shavings in a train from the furnace front to the uttermost part of the shop; accumulated dust of years that will compare favorably with gun powder; grease on every machine and under every line and counter-shaft hanger; oily waste, old polishing rags saturated

with oil; varnish, japan, turpentine, or benzine; a big stove to heat little glue pots stands in the middle of the room surrounded by the last mentioned compounds; piles of old hay, straw, or papers are off in one corner, to be used when occasion demands for packing goods; and perhaps men smoking in the middle of a pile of shavings every noon, if not during working hours. All these and many other causes combine to make insurance men steer clear of wood-working establishments, or if they are prevailed upon to write them up, charge anywhere from three to eight per cent. per annum, and then for only a small proportion of the value. I know of one firm taking out $15,000 insurance that had to get it divided up among thirty-two different companies because the risk was such that no single company wanted but a small portion.

There are many men engaged in the wood-working business that get insured for a comparatively small percentage, and are considered fair risks simply because they take every precaution, and insist on all their employes doing the same. These men reap their reward, not hereafter, but every day as they go along. To such a person it must be a source of trouble and care to be a tenant in the same building with those of the opposite disposition. He increases his vigilance, and also gets his insurance rates increased; He lives in dread and doubt every day, and dreams of the "imminent deadly foe" by night, but it does no good; just as likely as not, when he feels that he is in the least degree safe, his neighbour above, below, or at one side of him may be innocently doing all he can to burn him up, not intentionally, but by carelessness, and I might say cussedness. What else is it when one does what the commonest kind of horse sense dictates is dangerously wrong.

I verily believe that were the dynamite conspirators to take a few lessons in the destruction of property and life, by going through some of the factories in question, they could do a great deal more effective work—do it more easily, cheaply and quickly, and what is more there would never be any suspicion, arrest or trial, because evidence would show that thousands of business men all over the world had their buildings exposed in the same manner with their volition, and by their acts consider them safe.

I will cite a little experience a friend of mine had on this tenement question. I will call him Brown, which is not his name. Brown, Jones, and Smith, each occupies different stories of the same building. Brown has the first floor and basement, Jones the second and part of the third floor, and Smith the balance of the

third floor. Both the second and third floors are used for the manufacture of wood-work, brackets, bamboo chairs and the like, while Brown is engaged in the machine business. When Brown was the only tenant he paid only a minimum percentage of insurance, and owing to his vigilance and care felt perfectly safe. After a time the proprietor concluded to rent the upper stories to anyone that came along, even if it was a wood-worker. Jones and Smith came along and rented; insurance men came along also, and told Brown that his rates would be 135 per cent. higher. This galled Brown badly, but he had a long lease and there was no use kicking. He had to stay or fail in order to avoid the grip his landlord had on him. Jones and Smith moved in old dry goods boxes filled with straw, hay, etc., used varnish, turpentine, benzine, and oils of all kinds. They also moved in an immense amount of ignorance, carelessness, and "don't care" ativeness. Brown had the fire marshall look them up; marshall said Jones and Smith were going to reform and keep things in good shape. Things went on along for two years, when one of Smith's help about as tall as a half ton of coal let a spark fall from his pipe into a benzine vat; all hands in Smith's establishment moved out suddenly, and the whole top story of the building was in flames in five minutes. Finally the fire department got the best of it and extinguished it. Brown's property was not burnt any but was soaked through with water, and he was delayed for about two weeks; Smith did not loose much as he had a fair insurance—in fact, I think it would pay some people to get burnt out often, as it is one of the few ways in which they seem to be able to get any profits out of their business.

After everything was righted, all hands swore reform; fire pails were stationed and filled in every room; notices posted indicating what should be done in case of fire; instructions were given to keep pails filled with water and not to use them for any purpose except fire. Insurance agents and fire marshal put on more rigid rules, and all went lovely for a while, but after a time Smith's varnish barrels began to leak, and Jones complained that the varnish came down through the floor; Jones's varnish barrel began to leak, and Brown's men said that it did not make good hair oil and thought that Jones should move his varnish from directly over two of Brown's vises; Brown complained that Jones stopped up the varnish with a heap of saw-dust kept under the spiggot (new recipe for a fire from "an unknown source, probably an incendiary" fire). Finally the varnish leaked so fast

from Smith's barrels that it ran under the partition walls into Jones' upper room; the dust settled on it, and the other morning at seven o'clock the workmen had to fly for pails to put out an incipient fire. This led to another investigation. Brown who looked after the building generally, at the request of the landlord, found some of the fire pails used for washing purposes, and strewn all over the room while others were empty or nearly so. Brown remonstrated, and Smith cursed and swore he would use the pails as he liked and when he liked, and if that didn't suit, Brown could take them away. Brown thought this queer, particularly as the pails belonged to the building to be used only in case of fire, and were so placed for the good of all concerned. But no matter: Smith rented his room and did not propose to have any interference, besides, didn't he escape having a fire that very day while Jones had a fire in his part of the building? What matter if it was caused by the varnish from Smith's barrels; the fire did not start in his room. It did, however, originate in Smith's rooms, and he knew it. He was also mulish enough to use a pail because it was forbidden fruit, instead of a good wash sink for washing purposes.

Now what remedy is there for such a case as Brown's? He does not want to move out; he cannot stand guard and fight all the time, and he is fearful at all times and seasons. I suggested that he build a shop on a floating raft, put it on the lake, and induce Smith to move his business, and then keep a loaded cannon always pointed at the raft, to be discharged in case said raft drifted towards the shore. These incidents, together with many others, only tend to prove that a large majority of fires originate through, what might be termed with propriety, "criminal carelessness," and that this same carelessness is the cause of many fires which are written up as of incendiary origin. The laws, rules, and regulations must be changed vastly before people will protect even themselves or their own property, and what is more, they must be rigidly enforced.

It would seem that all men having a naturally hazardous risk in their business, would take at least ordinary precautions against ruinous losses. Their business would not suffer in consequence, but would go along much more smoothly; their insurance account would be cut down very materially, and their chances for delays and losses of business, diminished. Some people think that they must go to a great expense to accomplish these results, but this is their mistake. If they have a good exhaust fan, and system of

suction pipes to clear out the factory, they would save the labor of man power, and have a healthier as well as a pleasanter place in which to pass the day-time of their lives. They will also save a great deal of wear and tear of their mouths, spitting out saw-dust, etc. They could, if a moderate pressure could be had, introduce a system of pipes and automatic sprinklers overhead, which would in almost every case, quench a fire as soon as started. These sprinklers need no human aid, are always ready for duty, do not strike, or have any holidays or blue Mondays, and can be arranged to operate at almost any temperature desired. This plan has been very successfully and generally introduced in many of the cotton factories and large establishments both east and west, and are becoming very popular.

If one does not care to go to the expense of this system they should at least have a full supply of water barrels and pails stationed at frequent intervals throughout the building. Some of the old turpentine, varnish, or Japan barrels could be utilized. Rubber pails would be the best as they never shrink or fall to pieces, but if the wooden pails are kept filled they will not fail. They should occasionally be emptied and refilled to keep them sweet and clean; it should be a part of some one's business to see that all barrels and pails are looked after and kept full; men should be instructed at least enough to know their duty as soon as a fire is discovered; all kinds of refuse such as oily rags and waste should be swept up and burned every evening; smoking should not be allowed about the premises under any consideration; all inflammable liquids such as varnish and the like should be kept in a separate building, and should a water system be in the vicinity, or steam kept up all night, and a watchman employed, a good line of hose should be attached and ready for service Having taken all these precautions, you will be prepared to extinguish any incipient fire that may occur, but it won't occur, at leasthardly—that is I mean to say not frequently. Why? Because the very men employed to handle the fire are also a means to prevent the same, and that is the secret. Keep up the prevention day after day and year after year, and you may rest assured that your chances of getting the insurance appraisers and adjusters around will be very small.